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TWO NEW AUSTRALIAN VELVETFISHES, GENUS
PARAPLOACTIS (SCORPAENIFORMES: APLOACTINIDAE),
WITH A REVISION OF THE GENUS AND COMMENTS ON
THE GENERA AND SPECIES OF THE APLOACTINIDAE

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ABSTRACT: The velvetfish genus *Paraploactis*, formerly consisting of a single species, *P. trachyderma* Bleeker, 1865, from Queensland is revised to include several species previously referred to *Cocotropus* and two new species: *P. intonsa* and *P. pulvinus* from Western Australia. Specimens referred to four nominal species: *Tetraroge kagoshimensis* Ishikawa, 1904, in Jordan and Starks from Japan, *Cocotropus obbesi* Weber, 1913, from the Sulu Sea, *Aniculerosa taprobanensis* Whitley, 1933, from Sri Lanka, and *Cocotropus hongkongensis* from Hong Kong make up an unresolved complex also referable to *Paraploactis*. Members of the *Paraploactis kagoshimensis* complex are the least specialized of the species of *Paraploactis*, *P. trachyderma* and *P. pulvinus* being the most specialized. This specialization is reflected in increases in depression of the body, development of cirri on the snout, fleshiness of the ventral surface of the mandible, and development of a unique fleshy pad on the isthmus. Scanning electron photomicrographs show that scales of species of *Paraploactis* form spinous points. The species are described and figured, phenetic and cladistic analyses presented, and a key provided. Tables of the nominal genera and species of the Aploactinidae are given as is a discussion of features characterizing the family.

INTRODUCTION

Among the families of the Scorpaenoidei (*sensu* Greenwood et al. 1966), perhaps none is more unusual than the Aploactinidae. These fishes, about 24 species in number, are characterized by having a dorsal fin originating far forward on the cranium, a head invested with knoblike lumps, and a body usually covered with modified, prickly scales (hence, the name velvetfishes). In addition to these features, and quite un-

usual to scorpionfishes and their relatives, aploactinids show a loss of pungent fin spines, and some may be nonvenomous. If so, they would seem even more remarkable as they appear closely related to the notoriously venomous synanceiine and tetragogine scorpaenids.

Essentially, all that is known of these fishes are a single review (Whitley 1933) based on Australian forms and relying heavily on the literature, a detailed regional study of the taxonomy

and morphology of three Japanese species (Matsubara 1943), a small body of information in original descriptions, and a few faunal lists. Aploactinids occur at scattered localities throughout the western Pacific and Indian oceans. They appear to be more numerous in the Indonesian and Australian regions, but this may reflect an inadequate knowledge about other areas. Members of the group are presumed to be primarily restricted to continental margins, though a few insular records are known: Waite 1903 (Lord Howe); Seale 1935, and Fowler 1959 (Fiji); Eschmeyer and Poss 1976 (Raoul). Little if any information exists on the depths at which some species have been taken. As a group they are known to occur from nearshore to 510 m. Based on limited information for a few species, it is suspected that most live within interstices on rocky or coral-rubble bottoms, bottoms with coralline algae, or among vegetation. Their virtual absence in museum collections (most being known from one or a few individuals) can presumably be explained by their presence in these difficult-to-sample habitats. They are small in size and cryptic in appearance, factors which would further add to the difficulty of their capture.

The spelling Aploactidae has commonly been used in the literature (e.g. Waite 1921, 1923; Jordan 1923; McCulloch 1929; Whitley 1933; Berg 1940; Scott 1942; Munro 1955, 1967; Scott 1962; McKay 1970; Scott et al. 1974). This compound name was derived by Temminck and Schlegel (1843:51) from the Greek *aplos* (simple) + *aktis* (ray), in reference to the unbranched fin rays in the Japanese species *Aploactis aspera*. The spelling Aploactinidae, though less common (Greenwood et al. 1966; Nelson 1976; Scott 1976), is grammatically correct. However, according to amended Article 29 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1974:81), a family group proposed before 1961 based on an incorrectly formed stem is not to be amended for that reason if it is in general current use. (General current use is defined (ibid. 1964:87, 88, Article 79) as requiring at least five different authors in at least ten publications.) Thus, the name Aploactidae, based on an incorrectly formed stem, can be considered the correct spelling under the rule in effect at this writing. However, the Editorial Committee of the Commission has recently pro-

posed (ibid. 1977:170) removal of the provision (Article 29d) preserving original spelling. We suggest this amendment will pass and prefer the corrected spelling Aploactinidae for this family.

Although Matsubara (1943) in his classical work on Japanese scorpaenoids considered the group a subfamily (Aploactinae) of the broad family Scorpaenidae and demonstrated its relationship to other scorpaenoids, we follow most authors in recognizing a family Aploactinidae. We include in the Aploactinidae species referred to the family Bathyaploactidae (Whitley 1933), which were not treated by Matsubara (1943).

We discuss the features which have been used to characterize the family and present a list of all the nominal species and their current status. This is accomplished in a section preceding our review of the genus *Paraploactis*.

The genus *Paraploactis* includes the largest aploactinids. Several of the Australian species are fairly well represented in museum collections. Specimens from other areas are rare and present problems in classification at the species level, as is shown in the text.

Among fishes of the genus *Paraploactis*, the isthmus may bear a fleshy pad. This structure in its most developed condition might be used as a sucking disk. We describe two new Australian species, review and more precisely define the limits of *Paraploactis*, cite new records, and speculate, where possible, on the biology and phyletic relationships of the species.

METHODS

Methods for taking fin ray counts and measurements follow those of Eschmeyer (1969). The last two rays of the dorsal and anal fin are borne on a single pterygiophore and counted as one ray. Spines and rays are difficult to distinguish and all counts were checked against radiographs. Several nonstandard counts and measurements useful in differentiating species of *Paraploactis* were made: papillae per mandibular cirrus (fleshy projections counted on fourth left cirrus); number of cirri along outer lower margin of mandible (counted on both sides of mandible); number of cirri along inner lower margin of mandible (counted on both sides of mandible); length of cirri on snout (length of first cirrus anterior to left lachrymal bone); length of cirri on nasals (length of longest cirrus on left nasal bone); distance between interorbital ridges (from outer edges of interorbital ridges at pos-

terior border of interorbital pit); pad length (maximum length of pad); pad width (maximum width of pad).

Photomicrographs of the scales were made with a JEOL SJM-U3 scanning electron microscope at the Scanning Electron Microscope-Electron Microprobe Analyzer Laboratory at the University of Michigan (SEM-EMPA Lab). The skin was glow discharge coated with a 250-300 Å layer of gold prior to observation.

All numerical computations were performed with the MTS-MIDAS algorithms developed by the Statistical Research Laboratory at the University of Michigan.

Abbreviations of depositories of specimens are: AMS—Australian Museum, Sydney; ANSP—Academy of Natural Sciences of Philadelphia; BMNH—British Museum (Natural History), London; CAS—California Academy of Sciences, San Francisco; CMFRI—Central Marine Fisheries Research Institute, Mandapam Camp, India; CSIRO—Commonwealth Scientific Industrial Research Organization, Cronulla, Australia; FRSKU—Fisheries Research Station, Kyoto University, Kyoto, Japan; MCZ—Museum of Comparative Zoology, Harvard University, Cambridge; QM—Queensland Museum, Brisbane, Australia; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden; SAM—South Australian Museum, Adelaide, Australia; SU—Stanford University Collection (at CAS); USNM—United States National Museum of Natural History, Washington; WAM—Western Australian Museum, Perth; UW—University of Washington College of Fisheries, Seattle; ZMA—Instituut voor Taxonomische Zoologie, Zoologische Museum, Amsterdam.

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GENERA AND SPECIES OF THE FAMILY APLOACTINIDAE

In the only revision of the group, Whitley (1933) characterizes the Aploactinidae by their having 1) head spines which are not pungent but developed as knoblike processes, 2) modified scales which form spinous points or prickles, 3) anal spines which are either indistinct or absent entirely, 4) a dorsal fin which originates on the cranium, 5) fewer than four pelvic rays, the innermost of which is not adnate to the body, 6) no palatine teeth, 7) no gill slit behind the last arch, 8) no free pectoral rays, and 9) a toothed vomer. Of these features the last two are found in the vast majority of fishes and probably represent features primitive to the group (and disregarding the fact that some individuals of *Paraploactis* species lack vomerine teeth). Features 4, 5, 6, and 7, while apparently derived, are also present in the closely related tetrarogine and synanceiine scorpaenids. Features 1, 2, and 3

TABLE I. THE NOMINAL GENERA OF APLOACTINID FISHES AND THEIR CURRENT STATUS (TYPE-SPECIES IN PARENTHESES).

Genus (type-species)	Status	Remarks
<i>Acanthosphex</i> Fowler, 1938 (<i>leuynnisi</i>)	<i>Acanthosphex</i>	See original description
<i>Adventor</i> Whitley, 1952 (<i>elongatus</i>)	<i>Adventor</i>	Whitley 1952a
<i>Aniculerosa</i> Whitley, 1933 (<i>taprobanensis</i>)	<i>Paraploactis</i>	This paper
<i>Aploactis</i> Temminck & Schlegel, 1843, in Siebold, (<i>aspera</i>)	<i>Aploactis</i>	See Matsubara 1943
<i>Aploactoides</i> Fowler, 1938 (<i>philippinus</i>)	<i>Erisphex</i>	See Matsubara 1943
<i>Aploactisoma</i> Castelnau, 1872 (<i>schomburgki</i>)	<i>Aploactisoma</i>	See Whitley 1933
<i>Bathyaploactis</i> Whitley, 1933 (<i>curtisensis</i>)	<i>Bathyaploactis</i>	See original description
<i>Cocotropus</i> Kaup, 1858 (<i>echinatus</i>)	<i>Cocotropus</i>	This paper
<i>Erisphex</i> Jordan & Starks, 1904 (<i>pottii</i>)	<i>Erisphex</i>	See Matsubara 1943
<i>Insopiscis</i> Whitley, 1933 (<i>altipinnis</i>)	<i>Cocotropus</i> (?)	This paper
<i>Kanekonia</i> Tanaka, 1915 (<i>florida</i>)	<i>Kanekonia</i>	See Tanaka 1918
<i>Karumba</i> Whitley, 1966 (<i>ornatissima</i>)	<i>Karumba</i>	See original description
<i>Kleiwegia</i> de Beaufort, 1952 (<i>dezwaani</i>)	<i>Acanthosphex</i>	See Weber & de Beaufort 1962
<i>Membracidichthys</i> Whitley, 1933 (<i>obbesi</i>)	<i>Paraploactis</i>	This paper
<i>Neoploactis</i> Eschmeyer & Allen, in press (<i>tridorsalis</i>)	<i>Neoploactis</i>	See original description
<i>Paraploactis</i> Bleeker, 1865 (<i>trachyderma</i>)	<i>Paraploactis</i>	This paper
<i>Peristrominous</i> Whitley, 1952 (<i>dolosus</i>)	<i>Peristrominous</i>	See Whitley 1952a
<i>Sthenopus</i> Richardson, 1848 (<i>mollis</i>)	<i>Sthenopus</i>	See Weber & de Beaufort 1962
<i>Trichopleura</i> Kaup, 1858 (<i>mollis</i>)	<i>Stenopus</i>	See Weber & de Beaufort 1962

are specializations which are found only among species we include in the Aploactinidae. Not all species so included, however, possess all three features. Some, such as *Erisphex pottii* and *Kanekonia aniara*, have pungent head spines. Others, such as *Kanekonia florida* and *Sthenopus mollis*, lack all or nearly all prickly scales on the skin and have instead a smooth, fleshy skin. Several species within the genera *Erisphex*, *Kanekonia*, and *Cocotropus* have pungent anal spines. These spines tend to be weakly developed in large specimens and usually involve only the first spine. These genera are generally regarded as intermediate between the remainder of the aploactinid genera and those of scorpaenid subfamilies (see for example, Jordan and Starks 1904; Whitley 1933; Matsubara 1943; Smith 1958).

Species of the genera *Acanthosphex* and *Bathyaploactis* have somewhat pungent spines. Both genera are characterized by having the gill slits reduced to small openings, an apparently specialized feature which sets them apart from other aploactinids. They also have large pre-orbital spines, and fewer velvety prickles on the skin.

Although limited to but three Japanese species, the detailed anatomical work of Matsubara (1943) provides several additional and apparently specialized features which further characterize the Aploactinidae. His osteological exami-

nation of *Erisphex pottii*, *Paraploactis kagoshimensis*, and *Cocotropus masudai* revealed these forms to have: 1) six as opposed to seven branchiostegals (see below); 2) an apparently unique configuration and modification of the urohyal (see also Kusaka 1974); 3) an epiotic-opisthotic articulation in addition to the more common articulation of the epiotic with the ex-occipital, supraoccipital, pterotic, and parietal; and 4) the lateral ethmoids (ectethmoids) widely separated anteriorly from the vomer by cartilage. The last feature is known elsewhere among scorpaenoids in fishes of the scorpionfish subfamily Pteroinae. The first three features are not known to occur in other fishes of the sub-order Scorpaenoidea. Members of the Tetraroginae lack an epiotic-opisthotic articulation. The position of the anterior neural spines relative to the cranium is different in tetrarogines and aploactinids. The aploactinids *Peristrominous dolosus* and *Adventor elongatus* do not have the anterior dorsal spines originating on the cranium. This suggests that the advancement of dorsal spines onto the cranium may have taken place more than once in these fishes.

Examination of a cleared and alizarin-stained specimen of *Paraploactis intonsa* (CAS 39600) revealed the presence of seven (both right and left sides) rather than six branchiostegal rays. McAllister (1968) states that five or six branchiostegal rays are present in one (unspecified)

TABLE 2. THE NOMINAL SPECIES OF APLOACTINID FISHES AND THEIR CURRENT STATUS.

Original name (Species, genus)	Status	Remarks or Identification Source
<i>achrurus</i> , <i>Erisphex</i> , Regan, 1905	<i>Erisphex potti</i>	See Matsubara 1943
<i>altipinnis</i> , <i>Cocotropus</i> , Waite, 1903	<i>Cocotropus altipinnis</i>	This paper
<i>aniara</i> , <i>Kanekonia</i> , Thompson, 1967	<i>Kanekonia aniara</i>	See original description; generic placement uncertain
<i>aspera</i> , <i>Synanceia</i> (Aploactis), Richardson, 1844	<i>Aploactis aspera</i>	See Matsubara 1943
<i>asperrimus</i> , <i>Prosopodasys</i> , Günther, 1860	Uncertain	See original description
<i>australiensis</i> , <i>Erosa</i> , Borodin, 1932	<i>Paraploactis trachyderma</i>	This paper
<i>curtisensis</i> , <i>Bathyaploactis</i> , Whitley, 1933	<i>Bathyaploactis curtisensis</i>	See original description
<i>dermacanthus</i> , <i>Apistus</i> , Bleeker, 1852	<i>Cocotropus dermacanthus</i>	See Herre 1951
<i>de Zwaani</i> , <i>Cocotropus</i> , Weber & de Beaufort, 1915	<i>Acanthosphex leurynnis</i>	See Weber & de Beaufort 1962
<i>dolosus</i> , <i>Peristrominous</i> , Whitley, 1952a	<i>Peristrominous dolosus</i>	See Whitley 1952a
<i>echinatus</i> , <i>Corythobatus</i> , Cantor, 1850	<i>Cocotropus echinatus</i>	See original description
<i>elongatus</i> , <i>Membracidichthys</i> (Adventor), Whitley, 1952	<i>Adventor elongatus</i>	See Whitley 1952a
<i>florida</i> , <i>Kanekonia</i> , Tanaka, 1915	<i>Kanekonia florida</i>	See Tanaka 1918
<i>hongkongiensis</i> , <i>Cocotropus</i> , Chan, 1966	<i>Paraploactis hongkonginesis</i>	This paper
<i>horrenda</i> , <i>Aploactisoma milesii</i> , Whitley, 1933	Uncertain	See Scott 1976
<i>intonsa</i> , <i>Paraploactis</i> , Poss & Eschmeyer n. sp.	<i>Paraploactis intonsa</i>	This paper
<i>kagoshimensis</i> , <i>Cocotropus</i> , Ishikawa, 1904. in Jordan & Starks	<i>Paraploactis kagoshimensis</i>	This paper
<i>lichen</i> , <i>Aploactis</i> , de Vis, 1884	<i>Paraploactis trachyderma</i>	This paper
<i>leurynnis</i> , <i>Acanthosphex</i> , Jordan and Seale, 1906	<i>Acanthosphex leurynnis</i>	See Ramaiyan & Rao 1970
<i>masudai</i> , <i>Cocotropus</i> , Matsubara, 1943	<i>Cocotropus masudai</i>	See original description
<i>milesii</i> , <i>Aploactis</i> , Richardson, 1850	<i>Aploactisoma milesii</i>	Whitley 1933
<i>mollis</i> , <i>Sthenopus</i> , Richardson, 1848	<i>Sthenopus mollis</i>	See Weber & de Beaufort 1962
<i>monacanthus</i> , <i>Tetraroge</i> , Gilchrist, 1906	<i>Cocotropus monacanthus</i>	See Smith 1958
<i>obbesi</i> , <i>Cocotropus</i> , Weber, 1913	<i>Paraploactis obbesi</i>	This paper
<i>ornatissimus</i> , <i>Bathyaploactis curtisensis</i> , Whitley, 1933	<i>Karumba ornatissima</i>	See Whitley 1966
<i>philippinus</i> , <i>Aploactoides</i> , Fowler, 1938	<i>Erisphex philippinus</i>	See original description
<i>pottii</i> , <i>Cocotropus</i> , Steindachner, 1896	<i>Erisphex pottii</i>	See Matsubara 1943
<i>queenslandica</i> , <i>Kanekonia</i> , Whitley, 1952	<i>Kanekonia queenslandica</i>	See Whitley 1952b
<i>roseus</i> , <i>Cocotropus</i> (<i>Tetraroge</i>), Day, 1875	<i>Cocotropus roseus</i>	This paper
<i>schomburgki</i> , <i>Aploactisoma</i> , Castelnau, 1872	<i>Aploactisoma milesii</i>	See Whitley 1933
<i>siboldi</i> , <i>Aploactis</i> , Kaup, 1852	<i>Aploactis aspera</i>	See Matsubara 1943
<i>steinitzii</i> , <i>Cocotropus</i> , Eschmeyer & Dor, in press	<i>Cocotropus steinitzi</i>	See original description
<i>taprobanensis</i> , <i>Aniculerosa</i> , Whitley, 1933	<i>Paraploactis kagoshimensis</i> (?)	This paper
<i>tridorsalis</i> , <i>Neoploactis</i> , Eschmeyer & Allen, in press	<i>Neoploactis tridorsalis</i>	See original description
<i>trachyderma</i> , <i>Paraploactis</i> , Bleeker, 1865	<i>Paraploactis trachyderma</i>	This paper

aploactinid genus examined by him. In *P. intonsa* the anteriormost branchiostegal ray is little more than a small sliver of bone which is weakly attached to the ceratohyal.

Until the features noted by Matsubara for three species of Japanese aploactinids can be examined in the remainder of the group, the precise limits of the family and its status as an entity distinct from the related syanceiine and tetrarogine scorpaenids will remain obscure. We tentatively include the nominal genera listed in Table 1 and the nominal species listed in Table 2 in the family Aploactinidae.

Genus *Paraploactis* Bleeker

Paraploactis BLEEKER, 1865:168-169 (type-species *Paraploactis trachyderma* Bleeker, 1865, by original designation, monotypic). BLEEKER 1876a:200 (description). BLEEK-

ER 1876b:8 (description). WHITLEY 1933:100 (description). MARSHALL 1965:420, 434 (in key; compiled). SCOTT 1976:207-208 (compared with *Aploactisoma*).

Membracidichthys WHITLEY, 1933:102 (type-species *Cocotropus* [sic] *obbesi* Weber, 1931, by original designation). *Aniculerosa* WHITLEY, 1933:101 (type-species *Aniculerosa taprobanensis* Whitley, 1933, by original designation, monotypic).

DIAGNOSIS.—Aploactinid fishes densely covered with scales modified to form prickles, an elaborately sculptured head, and in some species a fleshy pad on isthmus. Frontal bone with two prominent ridges that diverge posteriorly, forming a pyriform depression between them. Dorsal fin originating on cranium over middle to rear of orbit. Dorsal fin membrane between spines 3 and 4 usually deeply incised so that first four spines nearly form a separate fin. Dorsal

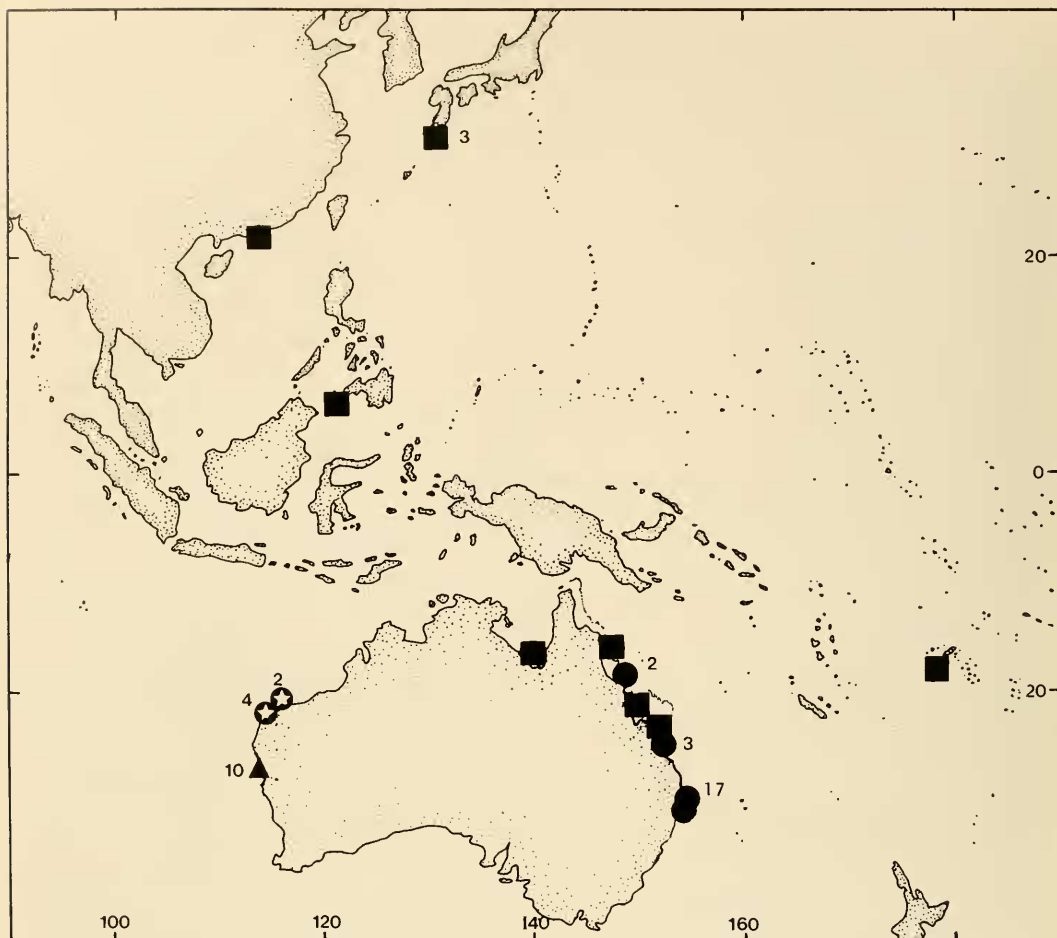


FIGURE 1. Distribution map for known records of species of *Paraploactis*. Circles represent *P. trachyderma*; circles with star, *P. pulvinus*; triangle, *P. intonsa*; squares, members of *P. kagoshimensis* complex. Not shown are two records of specimens belonging to *P. kagoshimensis* complex (*P. taprobanensis*) from Sri Lanka.

and anal fin spines often flexible and difficult to distinguish from soft rays; all fin rays unbranched. Total dorsal fin elements 22–24; with 13–15 spines and 8–10 soft rays. Anal fin with 1 spine (rarely 2) and 7–10 soft rays; total elements 8–11. Pectoral fin rays 13–14, usually 14, all unbranched. Pelvic rays 1 + 3. Head and body densely covered with prickly scales, larger scales above lateral line behind head. Lateral line scales, particularly anteriorly, as prominent knobs, total 11–15. Minute villiform teeth in jaws; palatine teeth absent; vomerine teeth sometimes absent or reduced. Gill rakers as blunt knobs, 6–11 total; 0–1 on upper arch, 5–9 on lower arch. Head with blunt, obtuse spines. Lachrymal bone (infraorbital 1) movable and

can be 'locked' outward; three spines on lachrymal bone, anteriormost small and pointing ventrally, posterior two large, one above the other, pointing mostly to rear with mouth closed. Suborbital portion of infraorbital series as a strong ridge with a lump in middle (on infraorbital bone 2), followed by two or three conspicuous obtuse spines (on infraorbital bone 3). Postorbital portion of infraorbital series with a single ossified element. Preopercle with five spines, uppermost largest, with a supplemental spine or lump at its base. No slit behind last gill arch. Gasbladder absent. Gasbladder muscle present, originating on occipital part of cranium, attaching to dorsal portion of cleithrum, passing posteriorly ventral to pleural ribs, and inserting

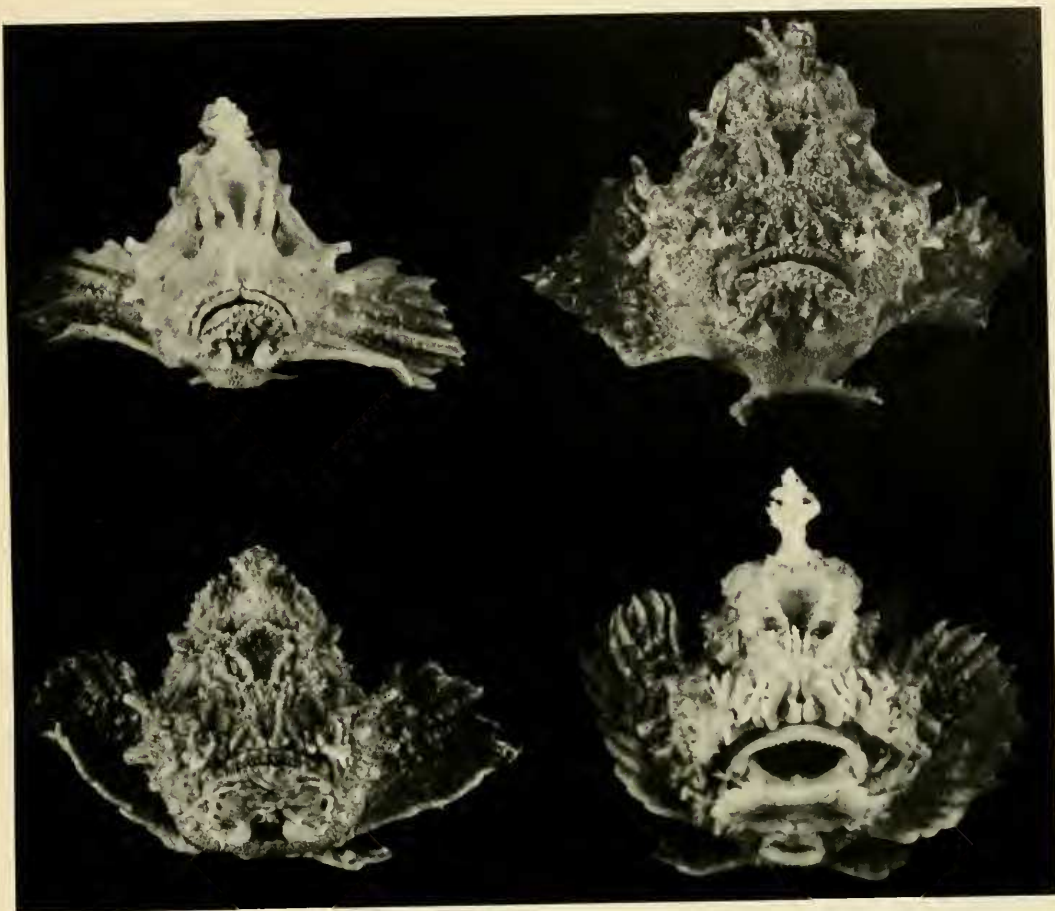


FIGURE 2. Frontal view of species of *Paraploactis*. Upper left: member of *P. kagoshimensis* complex (CSIRO 3237). Upper right: *P. intonsa* (holotype). Lower left: *P. trachyderma* (AMS I.12514). Lower right: *P. pulvinus* (holotype).

via distinct tendons to paraphophyses 6–11 (two species examined). Vertebrae 26–28. Branchiostegals 6 or 7.

DISCUSSION AND RELATIONSHIPS.—Many aploactinid species are in monotypic genera. *Cocotropus*, on the other hand, has been a 'catchbasket' genus in which a number of species have been described and to which other species have been assigned, including nominal species which we refer to *Paraploactis*. While limited material precludes definitive statements, we believe *Cocotropus* to be restricted to the following species: *C. echinatus* (Cantor, 1849; the type-species of *Cocotropus* Kaup, 1858), *C. dermacanthus* (Bleeker, 1852), *C. masudai* Matsubara, 1943, *C. monocanthus* (Gilchrist, 1906), *C. roseus* (Day, 1875), *C. altipinnis* Waite, 1903, and *C. steinitzi* Eschmeyer and Dor in press. We

refer *Tetraroge kagoshimensis* and its possible synonyms (most of which have been described in *Cocotropus* or referred to it) to *Paraploactis* as the "*P. kagoshimensis* complex." The genus *Paraploactis* otherwise contains *P. trachyderma* and the two new species described below. The distribution of the species of the genus *Paraploactis* is shown in Figure 1.

On the basis of overall similarity, species of *Paraploactis* are most closely related to species of the genus *Cocotropus* and may be considered a sister-group of all or part of that genus. *Cocotropus monocanthus*, in particular, is very similar in appearance to species of *Paraploactis*. Species of *Paraploactis* are, however, more specialized in a number of features. They have the posterior margins of the interorbital ridges diverging posteriorly (Fig. 2); the interorbital

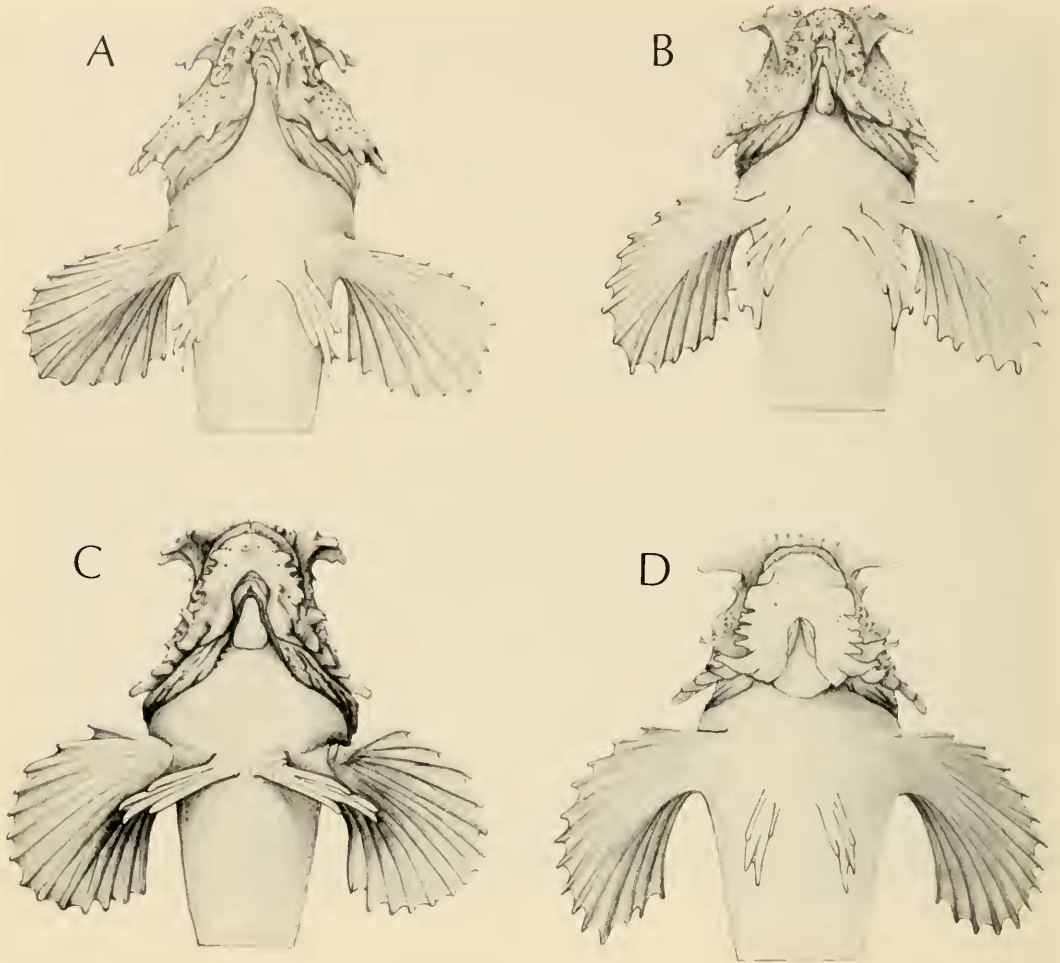


FIGURE 3. Ventral view of head in species of *Paraploactis*. A. Member of *P. kagoshimensis* complex (AMS IA.3951). B. *P. intonsa* (holotype). C. *P. trachyderma* (AMS 1.12514). D. *P. pubivinus* (holotype). (Drawn by Holly Wong.)

ridges of nearly all aploactinids and their relatives which possess them extend directly back without diverging posteriorly. Species of *Paraploactis* differ from those of *Cocotropus* in having the membrane of the dorsal fin between spines 3 and 4 deeply incised so as to form a nearly separate fin. The degree of incision is less in representatives of the *P. kagoshimensis* complex and greater in other *Paraploactis* species. Species of *Paraploactis* also have more depressed bodies than those of *Cocotropus*.

The fleshy pad on the isthmus and the associated modification of the underside of the head in some species of the genus *Paraploactis* represent a specialization unique among fishes. An

increase in complexity, as reflected in changes in the size and shape of the pad and apparently concomitant modifications of the external surface of the ventral part of the head is found within the genus. Representatives of the *Paraploactis kagoshimensis* complex show no development of a pad on the isthmus and show a full complement of cirri arranged in an inner and outer row on the ventral surface of the mandible (Fig. 3A). These fishes possess a somewhat fleshy projection of the anteriormost portion of the isthmus. A similar fleshy extension of the isthmus is present in all other aploactinids and, interestingly, in *Ptarmus gallus*, pataeids, and *Congiopodus leucomentopon*. It is reasonable to speculate

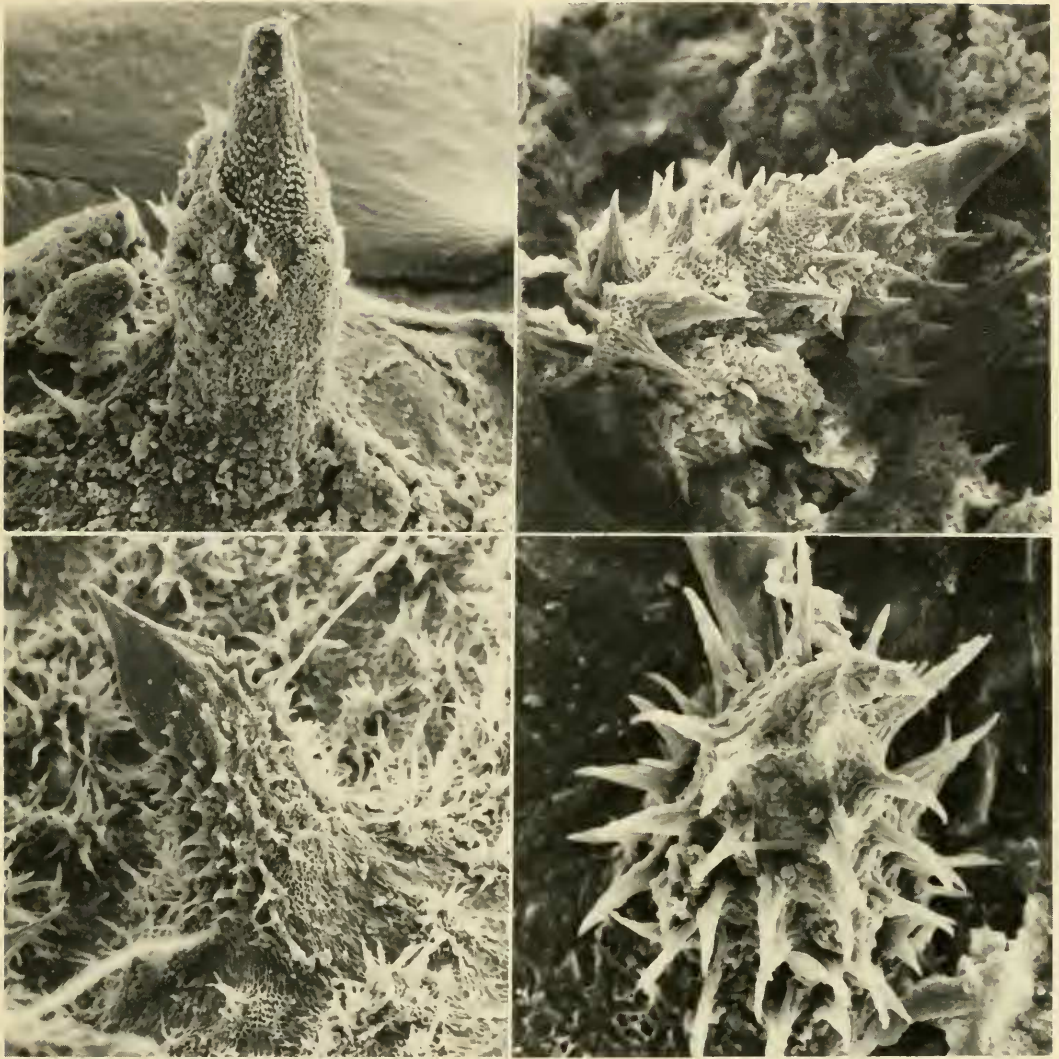


FIGURE 4. Scanning electron micrographs of scale from upper back of species of *Paraploactis*. Upper left: member of *P. kagoshimensis* complex, 185 \times (AMS E.2944). Upper right: *P. intonsa* 165 \times (WAM 5378). Lower left: *P. trachyderma*, 120 \times (AMS 1.12514). Lower right: *P. pulvinus*, 340 \times (WAM P23735).

that such a condition preceded the formation of the fleshy pad on the isthmus seen in other species of *Paraploactis*.

In *Paraploactis trachyderma* and *Paraploactis intonsa* a pad about $\frac{1}{4}$ – $\frac{1}{3}$ as wide as long is present on the isthmus. It is formed of thickened, somewhat spongy connective tissue and is less fleshy in *P. intonsa* (Fig. 3B) than in *P. trachyderma* (Fig. 3C). In the latter the ventral surface of the mandible is quite fleshy, the cirri along its inner margin are absent or appear as

small fleshy stubs, and the cirri along its outer margin are thickened and show no or a few well-developed papillae on the surface of the cirri.

Paraploactis pulvinus shows the greatest development of the pad (Fig. 3D). The pad is about $\frac{1}{2}$ – $\frac{3}{4}$ as wide as long and very fleshy. The ventral surface of the mandible is also extremely fleshy, cirri are entirely absent along its inner margin, and those along the outer margin are fleshy and flattened as in *P. trachyderma*, but to an even greater extent.

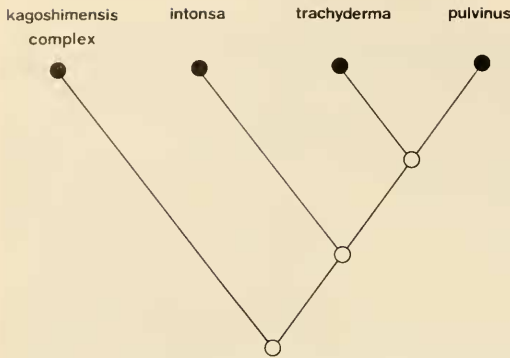


FIGURE 5. Cladogram representing the presumed phylogenetic relationships among species of *Paraploactis* (see text for discussion).

The adaptive or mechanical significance of the pad can as yet only be surmised. To our knowledge no aquarium or field observations have been made. The apparent trend toward loss of pigment and cirri on the ventral surface of the mandible and pad, and the shape and location of the pad suggest an intimate contact between the pad and the substrate. The pad may have originated as a structure to enhance stability on the bottom. With an increase in size and fleshiness, and an association with the overlying musculature, the pad might function as part of a sucking disc. The pad itself consists only of connective tissue. It is unknown if these fishes live in strong surge areas as some species of other fish groups (cyclopterids, gobiesocids, gobioids, sisorids) that have evolved ventral adhesive organs.

SEM photomicrographs of the prickly scales of species of *Paraploactis* are presented in Figure 4. Each scale consists of a circular base supporting a spinous process which emerges laterally and slightly posteriorly from the center of the base. The scale is covered with cornified epidermis, or cuticle, with numerous secondary projections. There is variation in prickle size and shape over the body. They are larger and tend to be bladelike on the upper back and smaller and more conical ventrally and posteriorly.

The presumed cladistic relationships among species of the genus *Paraploactis* are presented in Figure 5. This is based primarily on the development of the pad, including the size of the pad, the loss of cirri and pigment on the ventral surface of the mandible, and an increase in fleshiness of both the pad and the underside of the

head. That *P. pulvinus* is the most specialized, is further evidenced by the heavily ossified and sculptured interorbit and the large fleshy cirri on the snout. Although the pad is an unusual and, in fact, unique feature, we do not believe that its presence warrants generic separation of those having the pad from those lacking the pad.

PRINCIPAL COMPONENTS ANALYSIS.—A 45×46 matrix representing 45 characters for 46 individuals was standardized and the first six principal components extracted. The variables scored are given in Tables 4–7. All measurements were divided by standard length prior to standardization of the character variables (standard length was not otherwise included in the analysis). As one individual (CSIRO C2429) had a markedly abnormal anal fin, variables describing anal fin length and anal rays were excluded in forming the matrix. The specimen was also removed from an analysis using all 45 characters, the resultant scatter plots being only slightly different. Five specimens of *P. trachyderma* for which data were unavailable for all variables were also excluded. Results for the first two components are summarized in Figure 6.

Principal Component I. The major axis of variation in the sample has an eigenvalue of 10.8 and accounts for 24% of the total variance. Characters with the highest factor loadings on this axis are: body depth (.26), pad width (.25), pad length (.25), and snout to base of second dorsal spine (.25).

Principal Component II. This factor has an eigenvalue of 5.4 and accounts for 12% of the total variance. Characters with the highest factor loadings of this axis are: length of first dorsal spine (.37), length of third dorsal spine (.35), length of second dorsal spine (.33), length penultimate dorsal spine (.31), and length of last dorsal spine (.28).

Principal Component III. This factor has an eigenvalue of 4.2 and accounts for 9% of the total variance. Characters with the highest factor loadings on this axis are: vertebrae (.39), dorsal rays (.33), cirri on inner margin of lower jaw (.28), and number of papillae per cirrus (.28) (also anal rays (.38) and anal fin length (.29) when included).

Principal Component IV. This factor has an eigenvalue of 2.9 and accounts for 6% of the total variance. Length of cirri on snout showed a loading of .27. Characters with notable negative loadings on this axis are: caudal fin length

(-.34), jaw length (-.28), snout to base of third dorsal spine (-.26), and snout to base of fourth dorsal spine (-.25).

Principal Component V. This factor has an eigenvalue of 2.2 and accounts for 5% of the total variance. Characters with the highest loadings on this axis are: left gill rakers (.35), right gill rakers (.34), and orbit diameter (.27). Characters with negative loadings on this axis are: pectoral fin length (-.34) and interorbit (-.26).

Principal Component VI. This factor has an eigenvalue of 2.0 and accounts for 5% of the variance. The highest positive loading on this axis is fifth dorsal spine length (.23). Notable negative loadings on this axis are: distance between interorbital ridges (-.44), left gill rakers (-.39), right gill rakers (-.34), and last dorsal spine (-.30).

It is thought that the first three axes summarize the major differences among species of *Paraploactis*. Principal components I and II suggest the presence of a more or less continuous pattern of geographic variation in the specimens we assign to the *Paraploactis kagoshimensis* complex. The apparent continuity is not present in factors III-VI and may be the result of distortion of the 2-space defined by the first two components, which explain but 36% of the total variance. The overall amount of variation in the *P. kagoshimensis* complex is greater than that seen in other *Paraploactis* species and suggests the complex is composed of a heterogenous assemblage of species (see subsection "*Paraploactis kagoshimensis* complex").

KEY TO THE SPECIES OF *PARAPLOACTIS*

- 1a. Ventral surface of lower jaw smooth, not covered with prickles or papillose villi and with cirri almost entirely confined to outer margin (Figs. 3A, B) 2
- 1b. Ventral surface of lower jaw covered with numerous prickles or papillose villi and with cirri on both inner and outer margins (Figs. 3C, D) 3
- 2a. Minute cirri on snout, those in larger patch on tip of snout and across lachrymal bones about equal in size to those in smaller patch on nasal bones (Fig. 2). Fleshy pad on isthmus (Fig. 3A) with its width about 1/4-1/3 of length *P. trachyderma* (Fig. 7)
- 2b. Large, fleshy, and extensively branched cirri on snout; those in larger patches

- on tip of snout and across lachrymal bones very large, those in smaller patch on nasal bones smaller (Figs. 2, 8). Fleshy pad on isthmus (Fig. 3B) with its width about 1/2-3/4 of length *P. pulvinus* (Fig. 8)
- 3a. Fleshy pad present on isthmus (Fig. 3C), its width about 1/4-1/3 its length *P. intonsa* (Fig. 9)
- 3b. No fleshy pad on isthmus (Fig. 3D) "*P. kagoshimensis* complex" (see text)

Paraploactis trachyderma Bleeker

(Figures 1, 2, 3C, 4C, 5-7; Tables 1, 2, 4)

Paraploactis trachyderma BLEEKER, 1865:169-170 (original description; type locality Australia). BLEEKER 1876a:300 (in description of genus). MACLEAY 1881:141 (mentioned as from Australia). McCULLOCH 1915:272 (listed; senior synonym of *Aploactis lichen*). McCULLOCH & WHITLEY 1925:164 (listed; Moreton Bay; senior synonym of *Aploactis lichen*). McCULLOCH 1929:397 (listed). WHITLEY 1933:100-101, pl. xii, fig. 5 (listed; figured; from Queensland). WHITLEY 1954:29 (new record for South Australia, Cape Jervis). SCOTT 1962:162-163 (in key; brief description; figure). WHITLEY 1964:57 (listed). MARSHALL 1965:435, pl. 48 (common name; brief description; Queensland, South Australia; figured). SCOTT ET AL. 1974:184 (brief description; South Australia, Queensland; Western Australia record not this species). SCOTT 1976:205 (listed, Australia).

Aploactis lichen DE VIS, 1884:461 (original description; type locality Moreton Bay, Queensland).

Erosa australiensis BORODIN, 1932:90-91, pl. 2 (original description; type locality Southport, Queensland; figured). WHITLEY 1933:101 (compared with *P. trachyderma*).

MATERIAL.—RMNH 5892 (1, 114, holotype of *P. trachyderma*), Australia, no other data.

The remaining specimens from Queensland. QM I.11/75 (1, 103, holotype of *A. lichen*), Dunwich, Moreton Bay, donated G. Watkins. MCZ 33032 (1, 119, paratype of *Erosa australiensis*), Southport. AMS 1.7733 (1, 107), Moreton Bay, exchange, by J. D. Ogilby, 1906. AMS 1.12514 (1, 116), Moreton Bay, exchange Amateur Fisherman's Association. AMS 1.18673-001 (1, 112), Moreton Bay, presented J. Lewis, Dec. 1973. AMS 1A.6170 (1, 69.4), and AMS 1A.6171 (1, 37.8), Lindeman I., presented M. Ward, 1934. AMS 1A.6236 (1, 106), Cole I., near Lindeman I., presented M. Ward, 1934. AMS 1B.6346 (1, 86.2), Moreton Bay, presented R. J. Smith, 1963. AMS 1B.7567 (2, 47.3-102), Moreton Bay, 1966. ANSP 98678 (1, 98.5), Moreton Bay, T. C. Marshall, 12 Feb. 1952. FMNH 44968 (1, 89.2), Deception Bay, 27 Oct. 1952. QM 1.382 (1, 105), Moreton Bay, G. Mindham, 2 Apr. 1912. QM 1.467 (1, 86.5), Miora Banks, Harris and J. D. Ogilby, 28 May 1912. QM 1.510 (1, 92.5), Moreton Bay, J. Bancroft, 4 June 1912. QM 1.4733 (2, 25.0-97.4), Bowen, E. H. Rainford, 5 June 1931. QM I.12349 (1, 103), Moreton Bay, T. Marshall, 24 Oct. 1950. QM I.12350 (1, 108), Moreton Bay, 18 Apr. 1953. QM 1.2674-5 (1, 111), Moreton Bay. USNM 176933 (1, 83.9), Great Barrier Reef, 8 Apr.-29 May 1952, Col. Howard. UW 7289 (1, 96.8), Moreton Bay, T. Marshall, Oct. 1950.

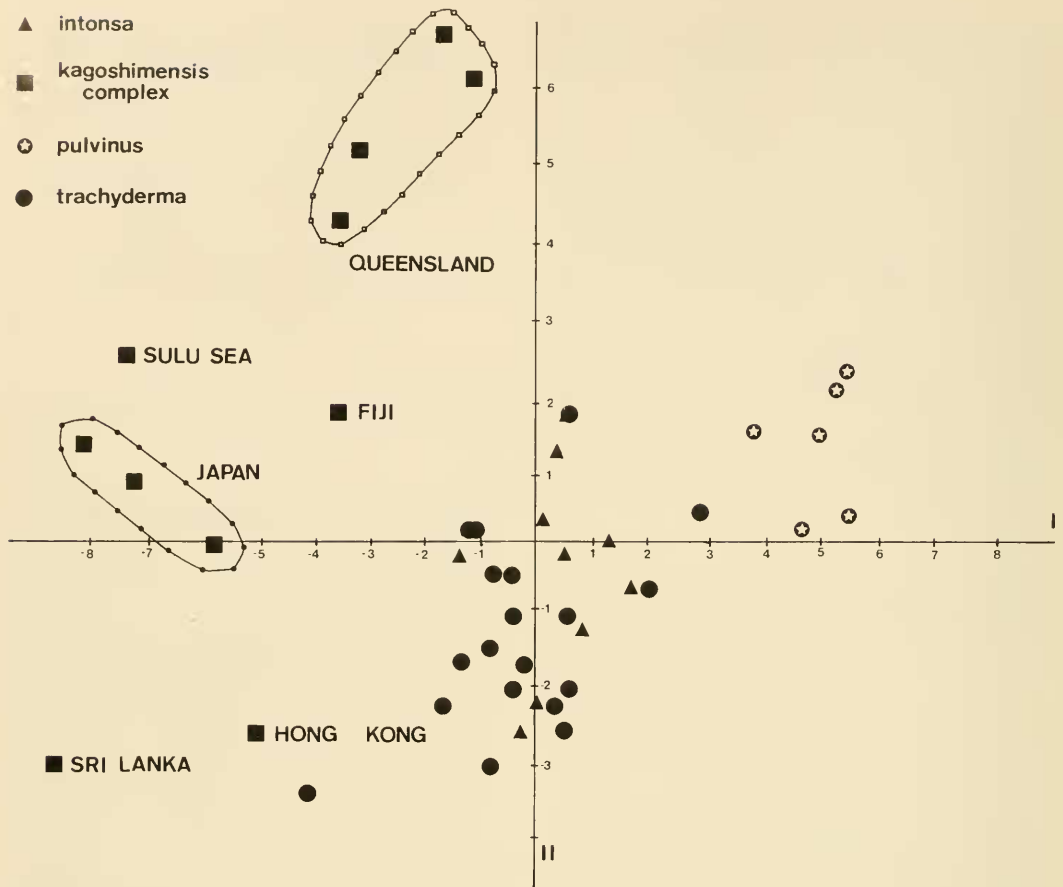
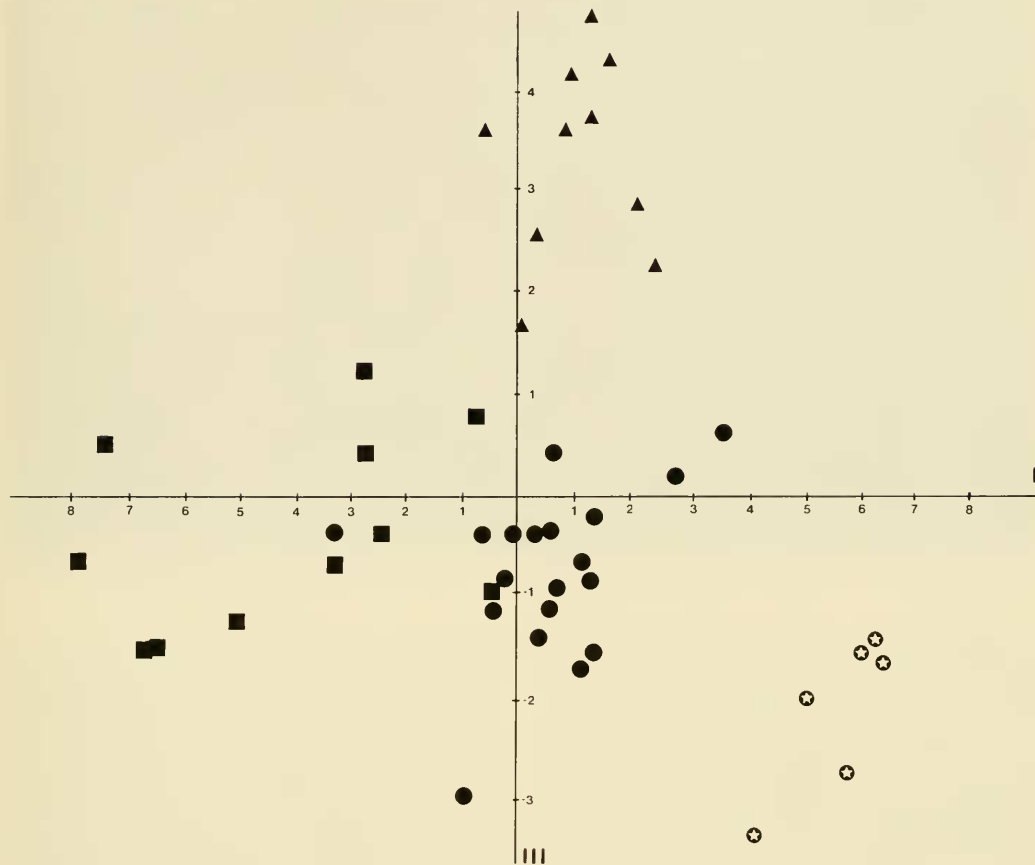


FIGURE 6. Results of a principal components analysis using 45 morphometric and meristic variables on specimens of the genus *Paraploactis*. Above: first and second major axes. Facing page: first and third major axes. (See text for discussion, variables; Tables 4-7 for data.)

DISTINGUISHING FEATURES.—(Measurements and counts are summarized in Table 4, body shape and color pattern in Fig. 7.) Ventral surface of lower jaw nearly smooth, with few papillose villi or prickles; about 5-11 fleshy cirri in row along outer margin; about 0-4 fleshy cirri in row along inner margin; fourth left cirrus (outer row) with 1-4 papillae. Fleshy pad on isthmus about $\frac{1}{4}$ - $\frac{1}{3}$ as wide as long (Fig. 3). Numerous minute stubby cirri on snout in two patches, those of larger patch across tip of snout and lachrymal bones about equal in size to those in smaller patch on nasal bones (Fig. 2). Vertebrae 26-28, usually 27. Dorsal fin rays XIII-XIV, 8-10, usually XIV, 9. Anal fin rays I, 7-9, usually I, 8. Live coloration unknown. Color in preservative (Fig. 7) brown with indistinct blotches and spots of darker and lighter brown on body

and fins. Black spot at base of last dorsal rays. Poorly defined, nearly white spot or blotch subterminally on upper rays of pectoral fin. About 6-10 dark brown bars radiating from orbit, particularly noticeable on ventral margin (Bleeker (1865) states these bars were rosy in color on his specimen). Several specimens with a nearly white snout.

DISTRIBUTION.—The type locality of *Paraploactis trachyderma* was given by Bleeker only as Australia. Subsequent records indicate this species is apparently confined to eastern Australia (Fig. 1). While most records have come from Moreton Bay, Queensland, this species is known to occur southward to Southport and northward at least to Bowen and the vicinity of Lindeman Island. Whitley (1954:29) reports a specimen (SAM F.2659) taken on a weedy bot-



tom at 20 m near Cape Jervis, South Australia, but this specimen could not be found for confirmation. Otherwise the most southerly occurrence for this species is Southport, Queensland. Other than Whitley's record (possibly not this species), no depth of capture information is available. An old collection note accompanying one specimen (AMS IA.6236) states, "This species is very sleepy and lies in crannies in dead coral boulders. Grunts when held in hand."

Paraploactis pulvinus Poss and Eschmeyer, new species

(Figures 1-6, 8; Tables 1-3)

No literature applies to this species.

MATERIAL.—*Holotype*: WAM P25528 (105 mm), Western Australia, Exmouth Gulf, CHALLENGER, trawl, 23 May 1971.

Paratypes: All from Western Australia. WAM P20123 (1,

119), Dampier Archipelago, NE Rosemary I., SE Elphics Knob, R. J. McKay, J. Stewart, A. Page, 5 Nov. 1971. CAS 39680, formerly WAM P24908 (1, 111), Exmouth Gulf, trawled, Aug. 1974. QM 1.12410 (1, 103), Exmouth Gulf, "Gutters Area," R. Rowe, trawled, 18.3 m, mud-silty bottom. WAM P23735 (1, 93.0), Exmouth Gulf, R. Rowe, Aug. 1973.

DIAGNOSIS.—Dorsal XIII-XIV, 9-10. Anal I, 8-9 (one abnormal specimen with I,4). Ventral surface of lower jaw smooth, without villi, 6-11 fleshy cirri confined to row along outer margin. Large fleshy pad on isthmus about $\frac{1}{2}$ - $\frac{3}{4}$ as wide as long (Fig. 3). Snout very steep (Fig. 8) with numerous elongate fleshy cirri (Fig. 2); those in larger patch across tip of snout and lachrymal bones longer than those in smaller patch on nasal bones. Lachrymal bone (infraorbital 1) with posterior two spines widely divergent; anterior-most spine very small.

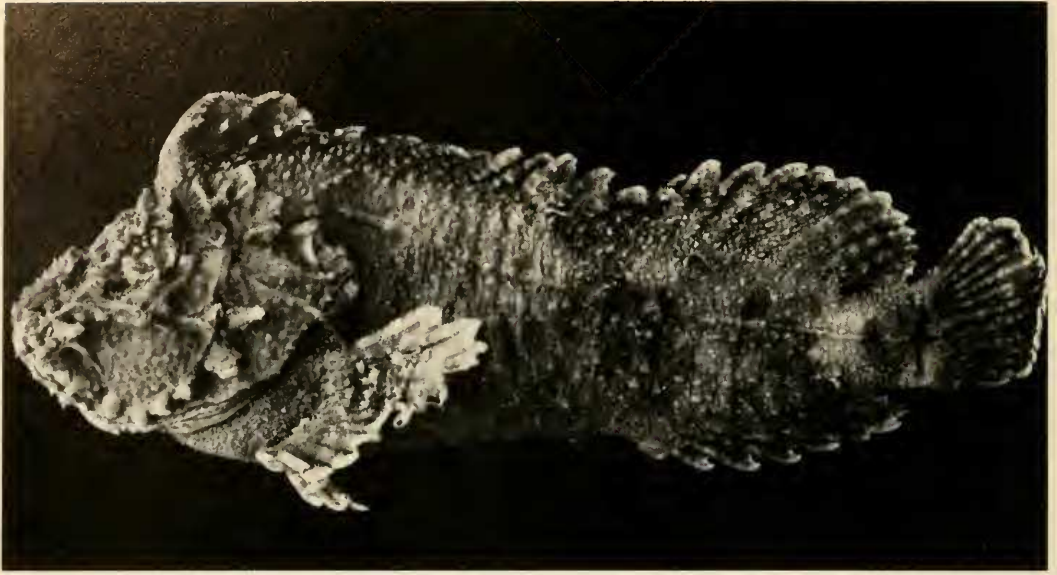


FIGURE 7. Lateral view of *Paraploactis trachyderma* (AMS 1.12514, 116 mm).

DESCRIPTION.—(Counts and measurements summarized in Table 3, body shape and color pattern in Fig. 8; based on six specimens.) A species of *Paraploactis* with features given under the genus above. Pectoral rays 14. Vertebrae 27. All gill rakers very short, stubby, total 7–11, 0–3 on upper arch, 7–9 on lower arch. Lachrymal bone (infraorbital 1) with three spines, anteriormost as inconspicuous lump, posterior two with points widely divergent (Figs. 7–8). Heavily ossified knobs, spines, and ridges on head, particularly in interorbit. Lateral line scales 12–14. Ventral face of lower jaw smooth, fleshy, without villi; 6–11 fleshy cirri in row along outer margin. Cushionlike pad on isthmus large, about $\frac{1}{2}$ – $\frac{3}{4}$ as wide as long, abutting fleshy posterior border of lower jaw anteriorly so as to form a dislike pad on ventral side of head (Fig. 3). Large tuft of elongate fleshy cirri across nasal bones, on lower cheek anterior to lowermost preopercular spine, and a few near proximal end of branchiostegals. Papillose cirri on pectoral fin and on spines of dorsal fin, very large on first three spines.

Color in life unknown. Color pattern in preservative, though variable, about as in Figure 8. Body buff to tan with darker brown markings in irregular patches or bands. Irregular bands or patches of black on fins. Pectoral fins whitish distally. Skin appears to be sloughing off

in two specimens (WAM P23735 and CAS 39680).

DISTRIBUTION.—*Paraploactis pulvinus* has been taken by trawling from Exmouth Gulf and Rosemary Island in the Dampier Archipelago and at Hampton Harbour, Western Australia (Fig. 1). At the first locality, one specimen (QM 1.12410) was trawled on a mud-silty bottom at a depth of 18.3 m. At Hampton Harbour a specimen (CSIRO 2429) was taken in a prawn trawl at a depth of 5.5 m.

ETYMOLOGY.—From the Latin *pulvinus*, a pillow, in reference to the fleshy pad upon which this fish rests its head.

***Paraploactis intonsa* Poss and Eschmeyer, new species**

(Figures 1–6, 9; Tables 1, 2, 5)

Paraploactis trachyderma (not of Bleeker): MEES 1960:20 (as new record for Western Australia; brief description [WAM P4714]).

MATERIAL.—*Holotype*: WAM P12100 (125 mm) Western Australia, Shark Bay, W. and W. Poole, Sept. 1963.

Paratypes: All from Western Australia. WAM P25840—001 (1, 128), Shark Bay, R. McKay. WAM P8923 (1, 126), Shark Bay, E. Barker, Oct. 1964. WAM P5874 (1, 121), Shark Bay, W. and W. Poole, July 1963. CAS 39599, formerly WAM P5378 (1, 118), Shark Bay, W. and W. Poole, June–July 1961. WAM P23605 (1, 114), Carnarvon, 24 m. dredged, P. Heald, 19 July 1972. WAM P4714 (1, 112), Shark Bay, Western Bay, R. J. McKay, July 1958. WAM P6069 (1, 111), Shark Bay, R. J. McKay. CAS 39600, formerly WAM P5388 (1, 110), cleared

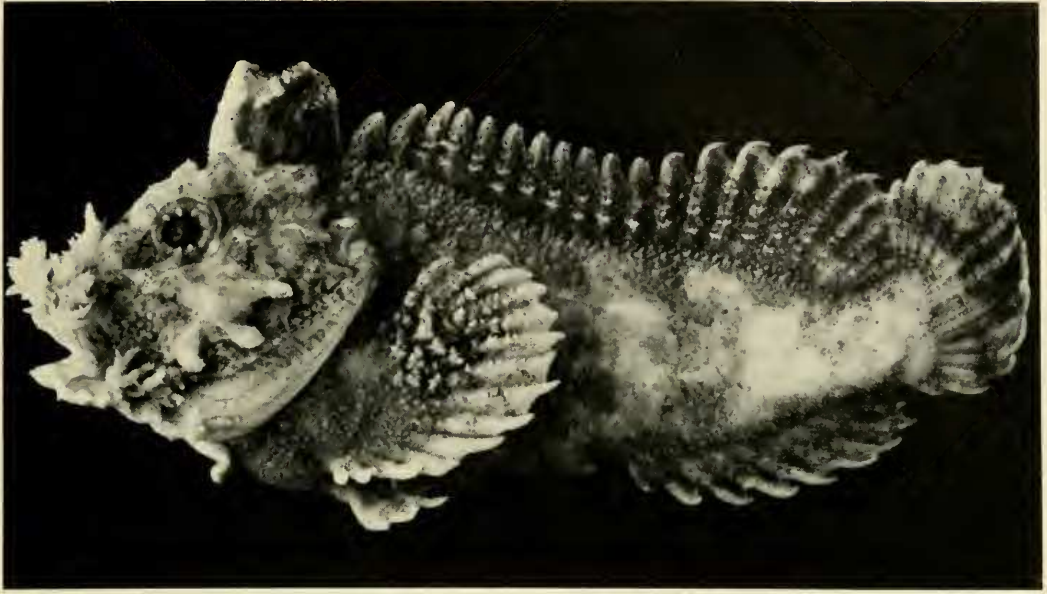


FIGURE 8. Lateral view of *Paraploactis pulvinus* (holotype, 105 mm).

and alizarin stained) and WAM P14683 (1, 97.5), Shark Bay, R. J. McKay.

DIAGNOSIS.—Dorsal XIV–XV, 9–11, usually XIV, 10. Anal 1, 9–10, usually 1, 9. Ventral surface of lower jaw with numerous villi and cirri on inner and outer margins. Fleshy pad on isthmus about $\frac{1}{4}$ – $\frac{1}{3}$ as wide as long (Fig. 3). Snout with numerous cirri (Figs. 3, 9).

DESCRIPTION.—(Counts and measurements summarized in Table 6; body shape and color pattern in Figure 9; based on ten specimens.) A species of *Paraploactis* with the features given under the genus above. Pectoral rays 14. Vertebrae 27–28, usually 28. All gill rakers very short, stubby; total 6–9; 0–2 on upper arch, 6–8 on lower arch. Lachrymal bone (infraorbital 1) with three spines, anteriormost small, posterior two larger, with points moderately divergent. Lateral line scales 12–15. Ventral surface of lower jaw with numerous villi and papillose cirri, 8–11 cirri in row along outer margin, 4–8 cirri in row along inner margin; fourth left cirrus (outer row) with 1–11 papillae. Cushionlike pad on isthmus about $\frac{1}{4}$ – $\frac{1}{3}$ as wide as long (Fig. 3). Band of papillose cirri across tip of snout and lachrymal bones. Papillose cirri over nasal bones, lower preopercular spines, pectoral fin, and dorsal spines; very large cirri on first three dorsal spines. Gasbladder masculature inserting

on parapophyses of vertebrae 6–11 [CAS 39399, formerly WAM P5378].

Body color in preservative white to tan with blotches or irregular bands of brown. Dark brown or black mottling on fins. The skin appears to be sloughing off in several specimens.

REMARKS.—Dr. R. J. McKay has kindly provided us (in litt., 13 July 1977) with the following additional information from field notes on species of *Paraploactis* taken during a trawling survey in Shark Bay in 1960. We assume these remarks apply to this species.

“Bottom was usually sand and silt, depths 7–9 fathoms. First dorsal spines capable of being locked erect and spines with posterior groove. When preorbital spine is locked erect this action withdraws the eye into the orbit. After freezing specimens the mucous layer may be rubbed off to reveal mottled coloration of the skin. Life colours were greyish, brownish; mottled with grey, pink and brown; pale grey blotched with pink or bright orange; purple-brown with pink or orange blotches; mostly orange with grey blotches; one specimen orange with some pink blotches below eye. Two mature females, total lengths 140 and 160 mm, running ripe on September 18, 1960. Eggs are small and orange in colour. In May, 1960 all females (14) were spent and contained white grey silt in gut.”

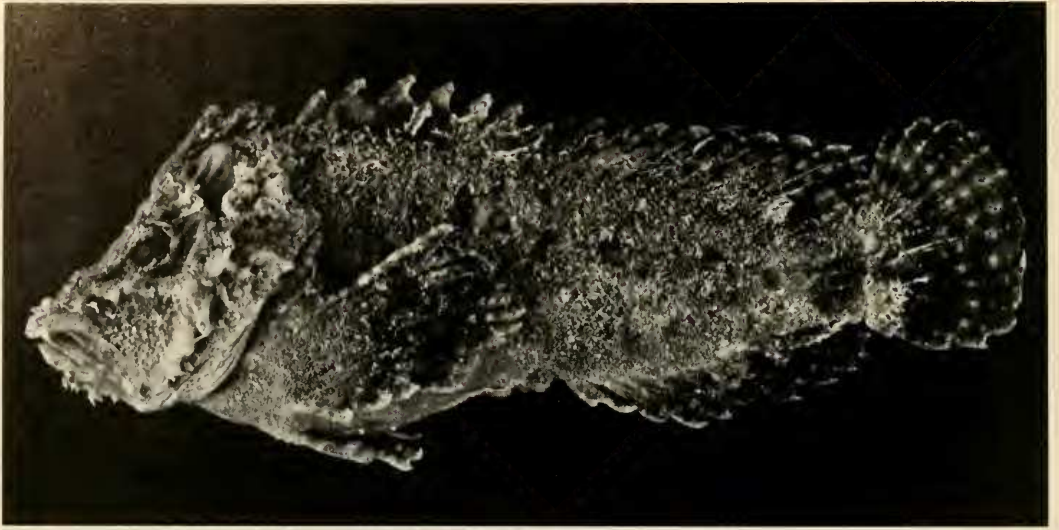


FIGURE 9. Lateral view of *Paraploactis intonsa* (holotype, 125 mm).

DISTRIBUTION.—*Paraploactis intonsa* is known from Western Australia in the immediate vicinity of Shark Bay (Fig. 1), in 7–24 m.

ETYMOLOGY.—From the Latin *intonsa*, bearded or unshaven, in reference to the numerous cirri on the lower jaw and snout which give the face a somewhat shaggy appearance.

Paraploactis kagoshimensis Complex

DISTINGUISHING FEATURES.—Dorsal fin rays XIII–XIV, 9–10; total 23–24. Anal fin rays I, 8–9. Numerous minute stubby papillae on snout. Ventral surface of lower jaw with numerous papillae; 8–12 cirri in row along outer margin of mandible; 4–5 cirri in row along inner margin of mandible. Fourth cirrus in outer row with 3–12 papillae. Isthmus without a fleshy pad, though ending anteriorly in a small fleshy lump (Fig. 3D).

REMARKS.—The *Paraploactis kagoshimensis* complex is composed of four nominal species: *Tetraroge kagoshimensis* Ishikawa, 1904, in Jordan and Starks; *Cocotropus obbesi* Weber, 1913; *Aniculerosa taprobanensis* Whitley, 1933; and *Cocotropus hongkongiensis* Chan, 1966. Because of the rarity of specimens, the status of these nominal species is uncertain. Judging from the specimens available to us, the complex probably represents at least four species, though a hypothesis of marked regional geographic differentiation within a single wide-ranging species can not as yet be rejected. As discussed above

(Principal Components Analysis), the amount of variation seen in this group is greater than that seen in other species of *Paraploactis*. That several species are represented is further substantiated by the failure of a single-linkage clustering attempt over all specimens to group representatives of this complex as a single unit. The results of another single-linkage clustering attempt in which a “city-block metric” is also used as a measure of phenetic distance and from which specimens not belonging to the *Paraploactis kagoshimensis* complex have been excluded are presented in Figure 10. We present below the features which we suspect corroborate a multi-species hypothesis for the complex, and where possible, attempt to assign the specimens available to us to existing names.

Paraploactis kagoshimensis (Ishikawa)

(Figures 1, 6, 10, 11; Tables 1, 2, 6)

Tetraroge dermacanthus (not of Bleeker): ISHIKAWA & MATSUÛRA 1897:50 (listed; Kagoshima, Japan).

Tetraroge kagoshimensis ISHIKAWA in JORDAN & STARKS, 1904:171 (original description; type locality Kagoshima, Japan; see remarks below). ISHIKAWA 1904:13–14, fig. 1 on pl. 7 (description).

Erisphex kagoshimensis: JORDAN & STARKS 1904:169, 171, 175 (placed in new genus *Erisphex* with type-species *Cocotropus pottii* Steindachner; in key; name and description from Ishikawa 1904; see remarks below). Jordan, Tanaka, & Snyder 1913:251 (listed; Kagoshima, Japan; common name Huurai-okoze). WEBER & DE BEAUFORT 1915:275–276 (compared with *Cocotropus dezwaani*).

Erisphex pottii: TANAKA 1931:36 (in part, *kagoshimensis* in

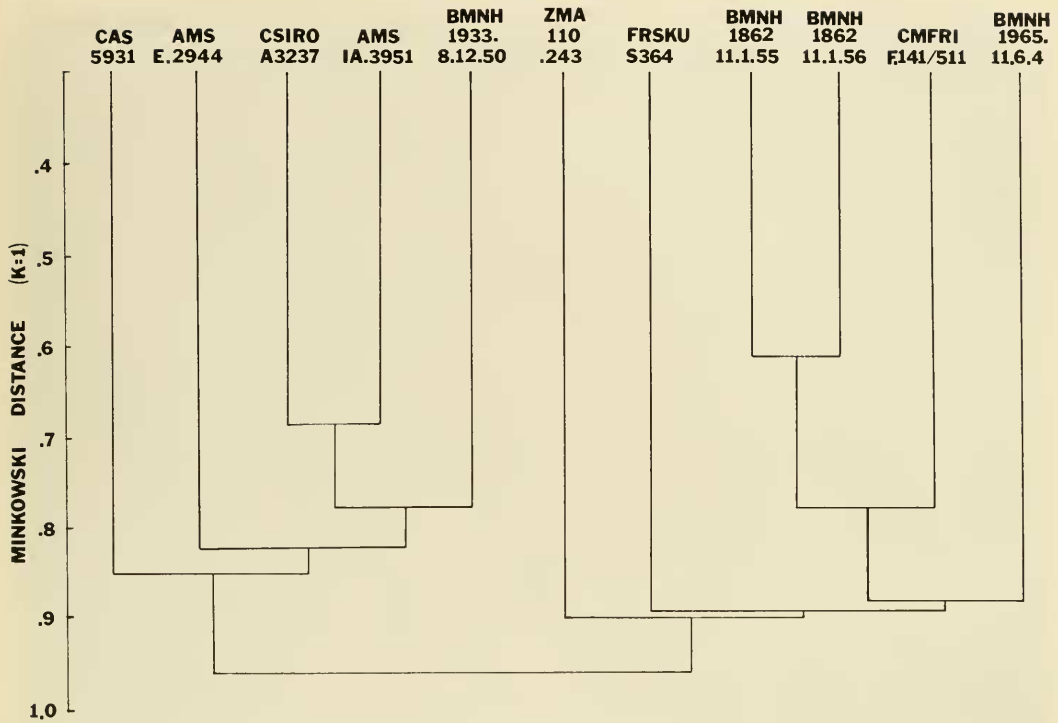


FIGURE 10. Phenogram of computed relationships among specimens of the *P. kagoshimensis* complex. (See text.)

synonymy). KAMOHARA 1952:69 (in part, *kagoshimensis* in synonymy). KAMOHARA 1964:75 (in part, *kagoshimensis* in synonymy).

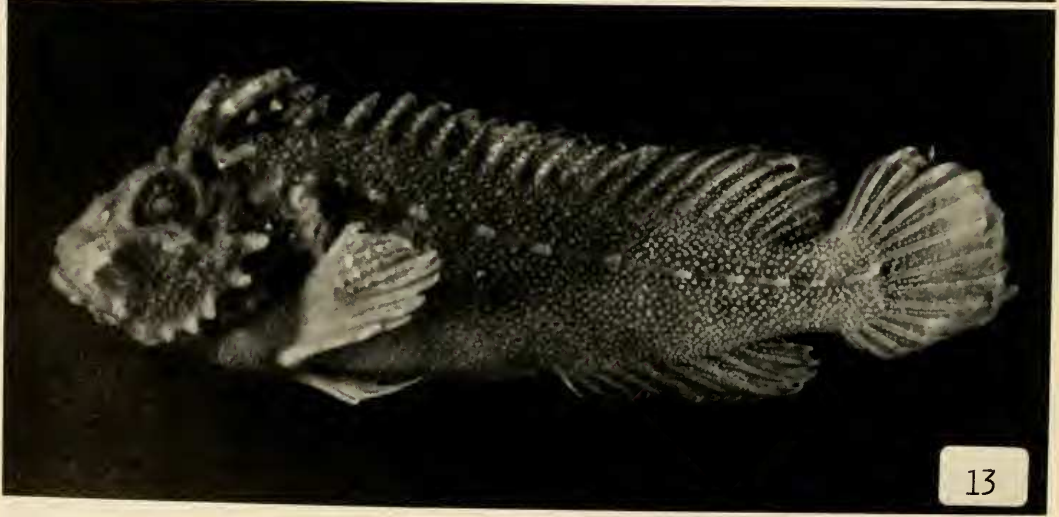
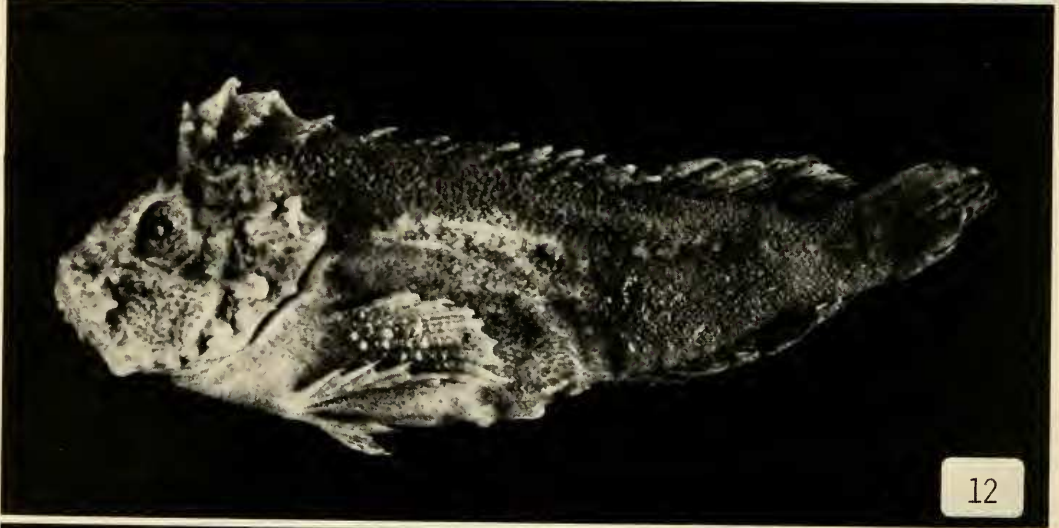
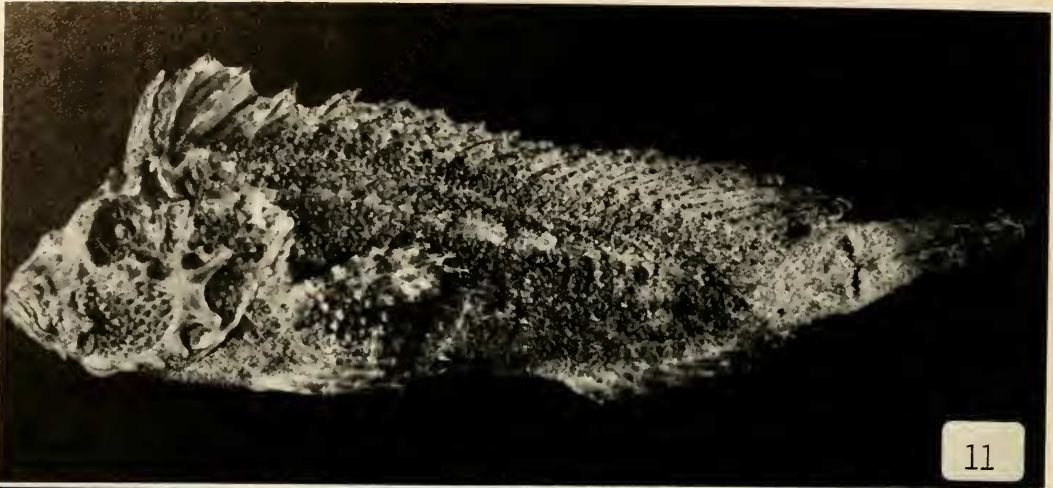
Cocotropus kagoshimensis: MATSUBARA 1943:467-470, in keys and figs., on earlier pages, fig. 155 (osteology; in keys; description of a specimen from Kagoshima). MATSUBARA 1955:1097 (in key; brief description). SHINO 1972:178 (common name Rough Velvetfish).

NOMENCLATURE REMARKS.—Jordan and Starks (1904:175) quoted Ishikawa's manuscript description of this species, used the scientific name selected by him, and cited him as the author of the species. They provided brief information about the species, included it in a key, and referred it to their new genus *Erisphex*. We believe that Ishikawa (*in* Jordan and Starks) was the person responsible for the "validating conditions" (see Article 50c, International Commission on Zoological Nomenclature, 1964) and was responsible, although perhaps not alone, for the "name and the conditions that make it available" (see Article 50a). This interpretation parallels the suggestion made by Sabrosky (1972, 1974) that the "conditions that make it [name] available" are the conditions other than publication. Ishikawa's manuscript was, however,

published 17 days after that of Jordan and Starks. The dates of publication seem reliable. The Jordan and Starks paper is listed in the table of contents of volume 27 of the *Proceedings of the United States National Museum* for 1904 with January 22, 1904, stated as the date of publication. On the inside back cover of Ishikawa (1904) the printing date is given as 5 February and the distribution date as 8 February 1904. We follow all previous authors, including Jordan and Starks, in recognizing Ishikawa as the author. The species should be cited as *Paraploactis kagoshimensis* (Ishikawa, 1904, *in* Jordan and Starks).

MATERIAL.—FRSKU S364 (1, 37.3), Japan, Kagoshima, M. Abe, no other data (specimen described by Matsubara 1943). BMNH 1862.11.1.55-56 (2, 71.1-85.1), Japan, purchase of Mr. Jamrach, no other data.

DISTINGUISHING FEATURES AND REMARKS.—We include here the specimens listed above. The type of *P. kagoshimensis* apparently is lost. Counts and measurements are presented in Table 7 and body shape in Fig. 11. Unlike some of the other specimens referable to the *P. kagoshimensis* complex, these have the membranes



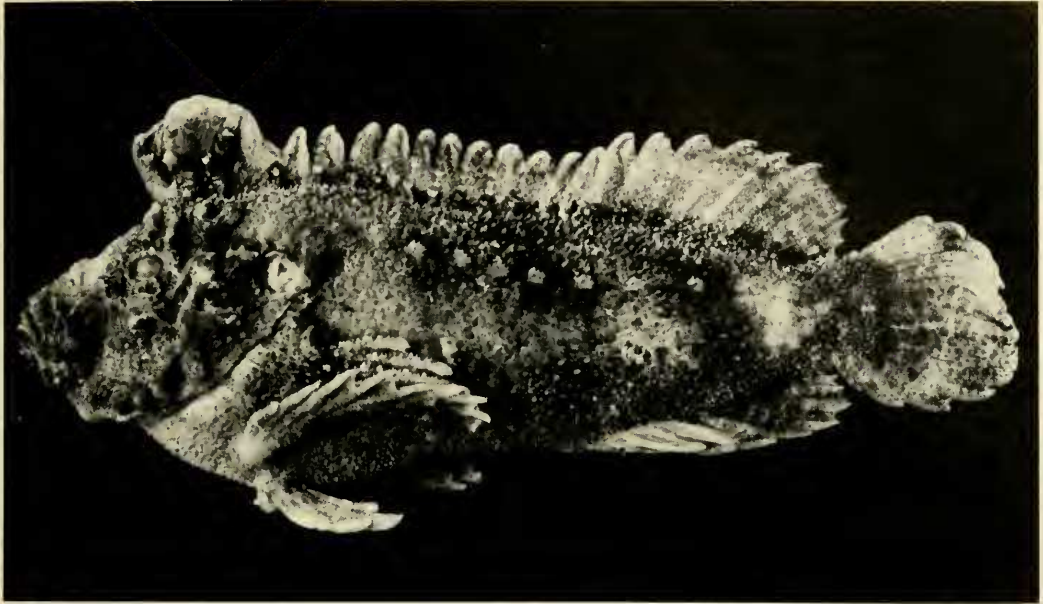


FIGURE 14. Lateral view of *Paraploactis hongkongiensis* (holotype, 95.2 mm).

of the spinous dorsal fin at the level of the sixth to tenth spines with the spine tips free of skin posteriorly. The dorsal spines are somewhat less flexible than in some other specimens. One Australian specimen (CSIRO A3237, see *Paraploactis* species) also shows these features.

***Paraploactis taprobanensis* (Whitley)**

(Figures 1, 6, 10, 12; Tables 1, 2, 6)

Aploactis aspersa (not of Richardson): JOHNSTONE 1904:202, 219, pl. 1, fig. 5 (description; from south of Adam's Bridge, Ceylon [Sri Lanka]; misspelled species name *aspersa* for Richardson's *aspera*).

Aniculerosa taprobanensis WHITLEY, 1933:101 (original description; based on Johnstone 1904). MUNRO 1955:241, pl. 48, fig. 5, (description; figure from Johnstone).

MATERIAL.—CMFRI F.141/511 (1, 83.2), se. coast of India, Veldalai, Gulf of Mannar.

DISTINGUISHING FEATURES AND REMARKS.—

Whitley did not see the specimen which Johnstone described. We have been unable to locate this specimen. Alwyne Wheeler (in litt., 31 Aug. 1975) has kindly informed us that both Johnstone and Herdman were associated with the

University of Liverpool, and following Herdman's resignation, his entire collection was disposed of by his successor. It seems likely that the specimen was lost at that time.

The specimen we list above fits the description given by Johnstone and is from the same general locality. The specimen differs from all others of the complex in the notably shorter lengths of the dorsal fin spines, and in lacking vomerine teeth. In other respects it is similar to *P. kagoshimensis*.

***Paraploactis obbesi* (Weber)**

(Figures 1, 6, 10, 13; Tables 1, 2, 6)

Cocotropus obbesi WEBER, 1313:503–504, figs. 104–105 (original description; type locality North Ubian I., Sulu Archipelago [generic name misspelled]). HERRE 1952:462–464 (description from Weber; in key; generic name spelled *Cocotropus* on p. 462). HERRE 1953:575 (listed).

Membracidichthys obbesi: WHITLEY 1933:102 (as the type-species of new genus; brief generic description).

Cocotropus abbesi: MATSUBARA 1943:472 (compared with *Cocotropus masudai*; specific name misspelled).

Erisphex obbesi: WEBER & DE BEAUFORT 1962:59–63, fig. 13 (description; in key; figure from Weber 1913).

←

FIGURES 11–13. Fig. 11. Lateral view of *Paraploactis kagoshimensis* (BMNH 1862.11.56, 85.1 mm). Fig. 12. Lateral view of *Paraploactis taprobanensis* (CMFRI F.141/511, 83.2 mm). Fig. 13. Lateral view of *Paraploactis obbesi* (holotype, 38.5 mm).

MATERIAL.—ZMA 110.243 (38.5, holotype of *Cocotropus obbesi*), Sulu Archipelago, anchorage off North Ubian I., 06°7.5'N, 120°26'E, 16–23 m, *Lithothamnion* bottom, M. Weber, SIBOGA sta. 99, 28/30 June 1899.

DISTINGUISHING FEATURES AND REMARKS.—The dorsal spines in this nominal species are somewhat more flexible than they are in other specimens of the complex and notably curved rearward at their tips, and the dorsal fin membranes at the level of the sixth to tenth spines are not free of skin posteriorly (Fig. 13). In these respects, it resembles a specimen of the complex taken from Fiji (CAS 5931) but from which it differs in number of pectoral rays (13 in the type, 14 in the Fiji specimen), an almost constant character in other species of *Paraploactis*.

Paraploactis hongkongiensis (Chan)

(Figures 1, 6, 10, 14; Tables 1, 2, 6)

Cocotropus hongkongiensis CHAN, 1966:12–16 (original description; type locality, Sharp I., inside of Port Shelter, Hong Kong).

MATERIAL.—BMNH 1965.11.6.4 (95.2, holotype of *Cocotropus hongkongiensis*), Hong Kong, West Shore of Port Shelter, the New Territories, 0.6–2.1 m, rotenone, bottom of rocks, boulders, and scattered patches of algae and sand, J. D. Bramhall.

DISTINGUISHING FEATURES AND REMARKS.—This presumed species is known only from the holotype (Fig. 14). Measurements and counts are presented in Table 7. It is the largest specimen referable to this complex. The dorsal spines are flexible, with the spine tips curved rearward. The dorsal spine tips are not free of membrane posteriorly. The membranes between dorsal spines at the level of spines 5–10 are deeply incised, more so than in *P. obbesi*. Also in comparison with *P. obbesi*, *P. hongkongiensis* appears to have a deeper body, especially posteriorly, more dark areas on the body, and a more compressed head with a long snout and more upturned mouth.

Paraploactis species

(Figures 1, 2, 6, 10; Tables 1, 2, 6)

Aploactis milesii (not of Richardson): SEALE 1935:365 (brief description; from Suva, Fiji Islands, [CAS 5931]). FOWLER 1959:357–358 (in part; one record from Fiji based on Seale 1935).

MATERIAL.—AMS IA.3951 (1, 57.7) Queensland, off Gatcomb Head, Port Curtis, 16.5–18.3 m, M. Ward & W. Boardman, July 1929. AMS E.2944 (1, 82.6), Queensland, 22.5 km SE of Cape Capricorn, 23.8 m, ENDEAVOUR, 29 July 1910. BNMH 1933.8.12.50 (1, 39.0), Queensland, Great Barrier

Reef, 0.4 km N of North Direction I., Great Barrier Reef Expedition. CSIRO A327 (1, 15.7), Queensland, Gulf of Carpentaria, RAMA sta. 158, 16°46.4'S, 140°25.0'E, 18.3 m, trawl, 15 Sep. 1963. CAS 5931 (1, 42.1), Fiji Islands, Vitti Levu, Suva, 24 Apr. 1933.

DISTINGUISHING FEATURES AND REMARKS.—The material listed above constitutes a rather heterogeneous group encompassing nearly as much variation as seen among the previously considered nominal species and probably represents more than one species. Some specimens appear similar to those from Japan, while others are similar to the specimen from the Sulu Sea. We are unable to assign them with certainty to any of the nominal species discussed above.

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TABLE 3. COUNTS AND MEASUREMENTS OF SPECIMENS OF *Paraploactis pulvinus*.

	Holotype					
	WAM P25528-001	WAM P29123	CSIRO C2429	WAM P24908	QM I.12410	WAM P23735
1. Standard length	105	119	95.9	111	100	93.0
2. Dorsal rays	XIV.9	XIV.10	XIV.9	XIV.9	XIII.10	XIII.11
3. Anal rays	1.8	1.9	1.4	1.8	1.9	1.9
4. Pectoral rays	14.14	14.14	14.14	14.14	14.14	14.14
5. Gill rakers (left)	1+8=9	1+7=8	3+7=10	0+7=7	2+6=8	1+6=7
6. Gill rakers (right)	2+9=11	1+8=9	3+8=11	0+8=8	1+6=7	2+6=8
7. Lateral line scales	12.13	14.14	14.14	14.12	12.13	13.14
8. Vertebrae	27	27	27	27	27	27
9. Head length	41.0	44.9	35.7	43.6	40.3	37.8
10. Snout length	18.9	17.9	13.4	16.2	14.7	14.6
11. Orbit diameter	7.0	8.4	7.6	8.3	7.4	7.1
12. Interorbital width	13.5	14.9	12.0	13.1	12.4	11.1
13. Jaw length	14.0	15.2	17.3	15.3	14.2	13.0
14. Postorbital length	19.1	22.2	16.5	21.7	19.5	18.1
15. Body depth	39.1	43.4	35.0	44.2	40.6	36.9
16. Predorsal length	27.9	29.3	24.6	27.9	26.6	23.6
17. Anal fin length	35.9	41.7	23.6	39.4	35.2	30.8
18. Caudal fin length	22.3	30.4	19.3	27.8	21.8	22.2
19. Pectoral fin length	21.8	26.5	23.2	29.0	23.1	26.6
20. Pelvic fin length	18.8	22.2	19.0	20.3	17.0	18.0
21. First dorsal spine length	13.2	13.1	10.4	13.2	14.3	12.6
22. Second dorsal spine length	13.8	15.9	12.2	14.2	14.2	14.0
23. Third dorsal spine length	12.0	14.7	12.1	14.2	13.7	12.6
24. Fourth dorsal spine length	12.0	12.0	8.0	10.6	9.8	9.1
25. Fifth dorsal spine length	12.0	9.5	8.1	12.2	10.3	9.4
26. Penultimate dorsal spine length	12.0	12.9	11.6	11.2	10.9	9.3
27. Last dorsal spine length	11.3	13.0	11.8	11.0	11.2	9.7
28. First anal spine length	4.9	6.9	6.6	8.7	5.2	4.3
29. Least depth of caudal peduncle	13.6	16.3	11.5	13.7	13.3	11.5
30. Snout to base of 2nd dorsal spine	30.4	32.8	26.8	31.0	30.1	28.2
31. Snout to base of 3rd dorsal spine	31.8	34.6	28.4	31.5	31.3	30.3
32. Snout to base of 4th dorsal spine	39.8	42.5	36.0	42.0	41.5	38.3
33. Snout to base of 5th dorsal spine	44.7	49.7	40.0	48.4	46.4	43.9
34. Distance between interorbital ridges	7.0	8.5	7.8	7.3	7.3	7.4
35. Papillae per cirrus	0	0	0	0	3	1
36. Cirri along outer margin of lower jaw	11	11	6	10	12	8
37. Cirri along inner margin of lower jaw	0	0	0	0	0	0
38. Pad length	10.5	9.6	9.0	11.8	12.7	7.9
39. Pad width	7.9	8.9	7.1	9.6	10.0	7.0
40. Length of cirri on snout	3.3	4.8	1.8	3.4	4.9	2.4
41. Length of cirri on nasals	4.8	3.5	1.3	5.3	2.0	1.9
42. Interorbital pit depth	3.2	2.8	2.8	3.2	3.2	3.0
43. Width 1st dorsal spine at midlength	2.7	3.8	3.0	3.5	3.9	2.7
44. Incision of dorsal fin membrane at fourth spine (from tip to membrane)	7.7	7.5	7.0	6.3	5.7	7.8

TABLE 4. COUNTS AND MEASUREMENTS OF SPECIMENS OF *Paraploactis trachyderma*. (Numbers at left refer to characters listed in Table 3.)

	Holotype RMNH 5892	QM 111/75	MCZ 33032	AMS 1A.6236	QM 14733	SU 20393	FMNH 44968	AMS 1A.6170	AMS 1A.6171	QM 1.4733
1.	94.8	103.4	102.8	106.5	97.4	90.0	89.2	69.4	37.8	25.0
2.	XIII.10	XIV.9	XIV.9	XIV.8	XIV.9	XIV.9	XIV.10	XIV.9	XIV.9	XIII.9
3.	1.8	1.9	1.8	1.7	1.8	1.8	1.9	1.8	1.8	1.8
4.	14.14	14.14	13.14	14.14	13.13	14.14	14.14	14.14	14.14	14.14
5.	1+6=7	1+7=8	1+8=9	1+7=8	1+6=7	0+6=6	1+5=6	1+9=10	1+7=8	2+5=7
6.	1+7=8	1+7=8	3+5=8	1+6=7	2+6=8	0+7=7	1+6=7	1+7=8	0+7=7	1+7=8
7.	15.14	13.12	12.13	13.13	14.14	15.15	13.14	13.13	14.14	14.14
8.	27	27	28	27	27	27	27	27	27	27
9.	94.8	41.6	39.3	42.9	40.0	34.1	37.5	26.4	15.3	9.5
10.	15.4	14.3	15.6	16.8	16.4	11.6	14.1	9.9	4.2	3.2
11.	6.7	6.0	7.0	7.5	5.9	6.1	5.3	5.0	3.3	2.0
12.	10.4	10.5	10.8	10.8	10.8	9.6	9.1	6.9	3.5	2.2
13.	13.2	13.3	13.1	14.6	13.4	11.8	13.5	10.3	5.7	3.3
14.	18.3	19.0	19.4	20.3	19.5	17.2	17.7	11.8	7.0	4.4
15.	31.3	35.0	37.1	35.1	32.3	31.4	34.5	22.8	13.7	7.8
16.	24.5	24.2	24.8	25.3	21.9	21.2	21.3	16.4	9.2	4.7
17.	27.3	29.1	31.8	33.6	32.3	28.8	31.8	23.6	12.4	7.5
18.	18.5	21.2	22.8	24.6	22.3	19.9	19.6	15.3	8.9	6.4
19.	17.5	22.8	22.9	20.3	21.4	18.1	21.9	14.7	8.8	5.5
20.	14.5	15.8	18.5	18.1	15.6	16.7	14.0	12.2	7.6	4.5
21.	10.4	11.7	11.9	10.9	11.1	10.0	11.2	7.8	3.7	2.4
22.	10.9	12.6	12.4	13.5	12.7	11.4	11.6	8.9	4.5	2.7
23.	11.3	11.0	12.3	11.7	10.8	10.7	10.8	8.2	3.1	2.1
24.	7.0	7.0	5.2	7.0	7.2	6.8	6.4	5.2	2.3	1.5
25.	7.3	7.2	5.6	7.6	7.4	7.0	7.4	6.1	2.5	1.3
26.	7.7	7.6	9.0	9.0	8.9	7.1	8.9	5.9	3.8	2.1
27.	8.2	8.3	9.1	9.1	10.5	7.4	8.3	5.9	3.8	2.4
28.	3.7	4.4	2.8	5.8	5.0	5.0	4.6	3.5	2.8	1.1
29.	10.9	11.0	11.7	11.9	12.1	10.7	11.6	8.8	5.1	2.8
30.	27.0	27.8	26.6	28.9	26.9	24.0	24.0	18.3	11.5	5.6
31.	27.9	30.5	29.1	31.3	30.3	26.3	26.7	19.5	12.5	6.6
32.	38.4	39.5	39.5	41.9	39.2	32.8	35.0	26.3	15.0	9.2
33.	44.0	45.7	43.2	46.1	44.6	37.8	40.0	29.7	15.8	10.0
34.	7.0	7.5	5.6	6.6	7.6	5.8	5.7	4.3	3.7	1.2
35.	1	2	1	1	2	2	0	2	3	6
36.	6	10	8	5	10	10	10	10	8	8
37.	0	3	0	4	2	2	2	2	2	4
38.	5.4	7.3	6.4	7.4	7.3	5.5	7.5	4.6	2.6	1.5
39.	3.3	3.9	3.4	3.4	3.4	2.2	3.7	1.8	1.2	0.7
40.	—	1.2	0.6	0.8	1.0	0.5	2.0	0.8	0.2	—
41.	1.0	0.4	0.8	1.3	0.6	0.8	1.2	0.5	0.2	0.1
42.	2.4	2.1	2.1	2.4	1.8	1.7	1.8	1.8	0.8	0.3
43.	1.5	3.0	1.6	4.0	3.3	2.3	1.5	1.5	0.7	0.3
44.	4.7	5.6	6.2	6.3	7.1	4.9	4.6	4.7	2.0	1.2

TABLE 5. COUNTS AND MEASUREMENTS OF TYPE-SPECIMENS OF *Paraploactis intonsa*. (Numbers at left refer to characters listed in Table 3.)

	Holotype WAM P12100	Paratype WAM P25840-001	Paratype WAM P8923	Paratype WAM P5874	Paratype WAM P5378	Paratype WAM P23605	Paratype WAM 4714	Paratype WAM P6069	Paratype WAM P5388	Paratype WAM P14683
1.	125	128	126	121	118	114	112	111	110	97.5
2.	XIV.10	XV.9	XIV.10	XIV.10	XIV.11	XIV.9	XIV.10	XIV.10	XIV.10	XIV.10
3.	1.10	1.9	1.9	1.10	1.9	1.9	1.10	1.9	1.9	1.9
4.	14.14	14.14	14.14	14.14	14.14	14.14	14.14	14.14	14.14	14.14
5.	1+7=8	1+6=7	0+6=6	1+7=8	2+6=8	2+7=9	1+6=7	1+6=7	0+7=7	0+7=7
6.	1+6=7	0+7=7	1+7=8	1+7=8	2+7=9	1+7=8	1+6=7	1+7=8	1+8=9	0+8=8
7.	12.12	13.14	14.15	12.12	13.15	14.13	14.14	14.14	13.15	15.14
8	28	28	28	28	28	28	28	27	28	27
9.	47.5	49.3	47.3	47.2	45.8	43.2	42.7	43.9	41.9	30.0
10.	18.3	18.9	17.6	20.0	17.8	17.4	17.5	17.1	16.8	14.1
11.	7.8	7.9	7.0	8.0	8.0	7.0	6.7	7.6	7.6	7.6
12.	10.8	13.3	12.6	12.4	11.9	11.9	12.9	12.8	10.8	10.2
13.	16.2	17.0	16.0	16.1	15.7	15.8	16.1	16.8	15.8	14.5
14.	24.0	23.8	22.1	22.0	21.2	20.1	20.7	21.7	20.9	18.3
15.	45.8	46.1	42.8	42.3	41.4	38.8	39.9	43.1	37.5	36.3
16.	27.3	31.9	28.5	31.6	28.7	28.0	27.1	29.1	25.9	24.4
17.	46.9	43.3	46.9	46.3	45.3	41.7	43.4	40.1	39.2	36.9
18.	29.1	28.8	29.0	22.3	28.7	26.5	27.4	24.6	23.6	23.0
19.	29.2	28.5	29.3	20.9	30.7	26.6	23.5	24.4	25.5	26.5
20.	21.9	24.3	21.6	20.3	19.8	19.6	19.5	20.5	20.8	17.8
21.	15.7	11.6	14.4	11.8	14.8	13.3	11.4	11.9	13.5	10.4
22.	16.0	11.8	14.7	12.9	14.0	13.4	11.8	12.0	14.1	10.7
23.	13.9	10.7	13.9	12.1	13.4	12.2	11.6	11.4	13.0	10.9
24.	10.2	8.6	9.2	8.7	7.7	10.5	9.9	8.0	7.0	7.0
25.	10.7	9.4	10.8	9.4	8.1	7.5	8.9	8.1	6.5	7.1
26.	13.3	10.3	11.1	11.3	11.7	11.2	10.7	11.1	10.3	9.2
27.	14.1	10.4	11.5	11.0	11.6	11.3	10.5	11.9	10.0	9.9
28.	7.1	5.4	5.6	6.3	5.7	6.7	6.5	5.9	5.0	5.3
29.	16.7	16.4	14.6	14.9	15.7	12.6	14.9	13.1	12.9	12.3
30.	32.0	36.3	33.9	35.7	32.0	31.7	29.9	32.0	29.6	27.9
31.	34.5	38.3	36.4	35.5	33.6	33.7	31.6	33.3	31.6	29.4
32.	47.3	45.3	47.1	45.0	43.3	43.4	42.1	41.4	39.0	37.7
33.	51.0	51.8	54.4	50.8	49.0	49.4	47.5	47.5	44.0	41.7
34.	7.0	7.7	8.1	8.8	7.0	6.4	7.3	8.3	6.7	6.1
35.	10	3	12	5	7	10	11	1	3	6
36.	12	12	12	11	10	13	11	12	8	12
37.	4	4	6	11	8	6	4	4	4	6
38.	9.2	9.0	8.0	7.8	6.8	8.0	6.9	7.6	8.9	6.8
39.	2.8	3.0	3.0	3.4	3.0	3.4	2.7	2.5	3.6	2.5
40.	1.6	0.5	1.2	1.5	1.1	0.9	0.4	0.5	1.2	0.2
41.	0.3	0.4	1.1	1.1	1.0	0.9	0.1	0.5	0.6	0.6
42.	2.4	2.5	1.8	2.5	2.4	1.6	2.2	1.6	2.1	2.2
43.	2.2	2.3	2.3	1.9	2.3	2.1	2.2	2.1	1.7	1.8
44.	10.2	4.8	4.6	5.2	6.5	8.7	5.8	5.5	4.0	5.4

TABLE 6. COUNTS AND MEASUREMENTS OF SPECIMENS OF THE *Paraploactis kagoshimensis* COMPLEX. (Numbers at left refer to characters listed in Table 3.)

	BMNH 1862 11.1.55	BMNH 1862 11.1.56	FRSKU S364	CMFRI F.141/511	ZMA 110.243	BMNH 1965 11.6.4	AMS 1A.3951	AMS E.2944	BMNH 1933 8.12.50	CSIRO A3237	CAS 5931
1.	85.1	71.1	37.3	83.2	39.8	95.2	57.7	82.6	39.0	80.0	42.1
2.	XIII,10	XIII,10	XIV,10	XIII,10	XIII,10	XIII,10	XIV,10	XIII,10	XV,9	XIV,10	XIV,9
3.	1,9	1,8	1,8	1,8	1,8	1,8	1,9	1,9	1,9	1,9	1,8
4.	13,13	13,13	13,-	13,13	13,13	13,13	14,14	14,14	14,14	14,14	14,14
5.	2+8=10	2+7=9	1+6=7	2+6=8	1+4=5	1+6=7	1+5=6	0+7=7	0+6=6	1+5=6	1+6=7
6.	2+7=9	2+6=8	0+6=6	1+6=7	2+4=6	2+5=7	1+6=7	1+6=7	1+6=7	1+5=6	1+6=7
7.	14,13	15,14	12,-	16,14	12,13	14,14	14,13	11,12	13,14	12,14	12,12
8.	27	27	28	27	27	27	28	27	27	28	27
9.	30.5	24.8	13.3	28.8	13.9	34.9	20.8	32.1	14.6	28.4	15.0
10.	10.2	7.5	4.2	10.3	4.8	13.2	7.7	11.9	4.1	9.9	5.4
11.	6.4	5.4	3.1	5.5	2.8	7.0	5.1	6.2	3.5	5.4	3.6
12.	6.9	5.8	3.2	6.9	3.9	8.6	5.8	7.8	4.1	7.0	4.2
13.	10.8	8.6	5.0	10.6	4.8	12.8	7.7	12.1	5.7	11.2	5.9
14.	14.0	11.5	5.7	13.5	6.3	15.6	9.2	14.0	6.6	13.2	6.7
15.	25.9	19.4	11.7	25.9	12.0	33.4	17.9	28.0	12.1	26.3	13.3
16.	17.9	9.2	7.3	16.0	7.6	21.6	12.5	19.3	7.7	16.9	9.1
17.	25.3	23.6	12.4	24.8	13.5	33.4	20.4	27.0	13.0	25.3	14.5
18.	18.1	16.9	9.1	16.3	9.0	28.8	14.0	20.1	9.0	18.1	11.4
19.	17.5	16.2	9.1	19.9	7.7	23.8	12.9	22.0	9.8	18.7	8.3
20.	13.2	12.4	5.7	12.6	7.5	17.7	11.0	15.7	7.8	13.8	7.4
21.	11.0	9.3	4.6	8.8	4.6	9.7	9.1	13.6	6.3	10.7	5.1
22.	12.8	9.4	5.3	9.8	5.5	12.7	10.0	14.6	7.2	11.5	5.3
23.	11.0	9.4	4.9	9.2	5.2	11.7	9.7	14.6	6.2	11.7	4.9
24.	6.6	6.8	3.8	4.5	2.7	9.2	4.9	8.8	3.6	7.2	3.0
25.	6.5	5.3	3.2	4.5	2.8	6.9	5.3	8.3	3.3	5.6	3.1
26.	7.8	7.0	3.3	6.6	4.3	9.2	6.9	8.2	3.9	9.8	4.1
27.	7.9	7.4	3.3	6.5	4.4	9.0	7.5	8.3	3.9	10.2	4.6
28.	4.7	3.7	0.6	3.5	2.2	5.7	3.0	4.4	2.5	3.3	2.7
29.	9.7	7.4	4.2	8.3	4.8	12.7	6.8	10.2	4.3	8.9	5.3
30.	19.7	17.1	8.5	17.3	8.3	24.4	15.7	23.8	10.4	21.3	10.9
31.	22.6	18.7	9.0	19.1	10.0	26.4	19.5	28.5	12.0	21.6	12.1
32.	28.9	22.2	10.3	24.2	13.0	32.3	20.5	29.3	14.3	25.0	14.4
33.	33.2	29.8	11.5	31.3	14.1	36.7	22.7	35.4	16.6	30.5	16.8
34.	4.5	3.6	2.2	4.2	2.5	5.7	5.2	5.2	2.2	7.2	2.1
35.	4	7	7	8	8	0	6	6	9	3	7
36.	8	9	8	12	12	8	12	10	10	10	8
37.	7	6	6	4	4	4	4	6	4	4	6
38.	0	0	0	0	0	0	0	0	0	0	0
39.	0	0	0	0	0	0	0	0	0	0	0
40.	0.1	0.1	0.1	-	0.1	0.1	0.2	0.1	-	0.2	0.2
41.	0.1	0.1	0.2	-	0.1	-	0.1	0.1	0.3	-	-
42.	1.9	1.4	0.5	1.3	0.4	1.9	1.7	1.7	0.6	2.0	0.8
43.	1.2	0.9	0.3	1.1	0.5	1.5	1.1	2.4	0.7	1.4	0.4
44.	2.2	2.1	1.5	2.3	1.3	4.6	1.8	3.6	1.2	2.1	0.9